



ARTIFICIAL INTELLIGENCE IN ENDODONTICS- A REVIEW.

Dental Science

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ABSTRACT

Identifying and treating conditions affecting the dental pulp and adjacent tissues is the main goal of the vital field of endodontics. In an effort to enhance diagnoses, artificial intelligence (AI) is being progressively added. Algorithms and machine learning are used by AI to analyse large data sets, identify trends, and produce accurate forecasts. Precise knowledge of illnesses affecting the pulp and periapical tissues is essential for accurate diagnosis and therapy planning. The anatomy of the root canal system is analysed, working lengths are established, periapical lesions and root fractures are identified, retreatment procedure success is predicted, and the survival of stem cells in dental pulp is estimated using artificial neural networks and convolutional neural networks, among other AI models. The purpose of this review is to assess the precision of artificial intelligence in endodontic dentistry in terms of diagnosis and prognosis.

KEYWORDS

Dental Pulp, Discern Patterns, Periapical Tissues, Root Canal System.

INTRODUCTION

Following World War II, the idea of artificial intelligence gained prominence, and John McCarthy first used the word in 1956. Since then, there has been no turning back.^[1] Some refer to it as machine intelligence. The "fourth industrial revolution," sometimes referred to as artificial intelligence, uses computer technology to mimic human-like critical thinking, decision-making, and intelligent behaviour.

Numerous office and practice management programs currently directly affect our daily lives as a result of artificial intelligence.

Artificial intelligence has been used by apps such as Siri, Alexa, and other voice command devices to provide intelligent conversational user interfaces for any device, application language, or environment. AI that is both virtual and tangible (i.e., robots) can be used in the healthcare industry. The primary domain of the virtual type is the mathematical formulae for appointment scheduling, drug interactions, electronic health records, imaging, diagnosis and prognosis, and medication dosing. Robotic assistance during surgery, telepresence, rehabilitation, and companionable robots for senior care are all included in the physical component.^[2]

AI technology has become a potent instrument in dentistry, transforming several facets of oral healthcare. Large data sets are analysed, patterns are found, and precise predictions are made through the application of algorithms and machine learning techniques. Dentists can improve patient care, diagnosis, treatment planning, and office management by utilising AI. In the field of diagnosis, AI systems are able to identify and diagnose oral disorders by analysing radiographs, pictures, and patient information. AI systems continuously improve their diagnostic precision through machine learning, which learns from enormous datasets. In addition to increasing diagnosis accuracy, this makes it possible to identify diseases early on, which results in improved patient outcomes and more prompt therapies.^[3]

AI and endodontics together could provide precise biomechanical preparation of the root canals. The development of clinical methods like AI-based diagnosis and assisted access cavity preparations to provide simple access to root canals, even in obliterated roots, has also been aided by the most recent developments in digital applications.^[4] Furthermore, the Food and Drug Administration's (FDA) recent clearance of a number of AI tools for dental image processing represents a major advancement in the practical application of AI in dentistry. Notwithstanding these developments, it is crucial to remember that clinical AI application in dentistry is still in its infancy and that further study is required to determine its efficacy and precision.^[5]

The identification of periapical pathosis, root fractures, working length assessment, and treatment result prediction are just a few of the

exciting uses for the AI models currently under investigation in the field of endodontics. To guarantee accuracy and consistency, it is crucial to construct these AI models using data gathered from seasoned medical professionals.^[6] The purpose of this study was to assess the diagnostic precision of endodontic artificial intelligence.

DISCUSSION

Periapical Pathologies

Precise examination of the peri-radicular condition is essential for endodontic therapy diagnosis, treatment, and healing assessment. However, according to some published research, periapical lesions are thought to remain undetectable until somewhat severe bone deterioration has occurred, meaning that the lesion must erode the cortical-cancellous bone interface.

Radiographs are not a perfect source of this information. Nevertheless, research by Low et al. and 'LoffHag Hansen' et al. demonstrated that CBCT can identify apical radiolucency in the cancellous 2 cortical bone, which is typically obscured by the superimposition of irrelevant structures onto the features of interest.^[7]

About 75% of instances with radiolucent jaw lesions are caused by the common disease apical periodontitis.^[8]

Since CBCT imaging is expensive and exposes patients to radiation, its application is restricted to certain clinical situations. Notably, its accuracy in identifying apical periodontitis in teeth with filled roots declines.^[9]

Lee et al. also showed that while evaluating the treatment plan, AI-based machine learning algorithms will be a useful tool for estimating the prognosis of the teeth. To maintain long-term dental health and function and diagnose tooth prognosis, a thorough treatment plan must be taken into account.^[10]

Determination of Working Length

A working length that is too short may leave contaminated tissue in the root canal, which may further harm the periapical tissue. Therefore, accurate working length estimation is essential for endodontic success. The actual apex (apical foramen) and the radiographic apex do not always line up.^[7]

There aren't many studies on determining working length and identifying apical To improve the accuracy of radiography's working length determination, Saghi's study, among others, proposed that artificial neural networks might serve as a second opinion in locating the AF on radiographs. Furthermore, ANN can be used as a decision-making tool in a number of comparable clinical scenarios.^[11]

Decision of Retreatment in Endodontics

Since the latter part of the 20th century, there has been discussion over

how to evaluate treatment outcomes in endodontics. The primary cause of this is the intricacy of the periapical healing process, which, as has been well-documented, typically takes a year but may take up to four or ten years.^[12] A persistent periapical radiolucency has frequently been cited as a sign of endodontic retreatment and as a criterion of endodontic "failure." Decision analysis has been suggested as a substitute decision-making method.^[13]

An inventive approach created especially to assist odontologists in making decisions regarding retreatment was only provided in one study by Campo et al. By ranking the established factors, especially those with the highest risk factor, we were able to predict the final treatment and retreatment solution in 84.4% of the instances, demonstrating the relevance of the data collected with the CBR study.^[14]

Pulp Chamber Segmentation

Since CBCT's three-dimensional feature gives more information about the teeth and the structures around them than traditional radiography's two-dimensional images, its use in endodontics is expanding quickly across the globe. However, the picture that was shown to the dentists. Its two-dimensional and hazy; visualising the teeth's three-dimensional structure mostly relies on clinical expertise; in particular, dental pulp regeneration is one of the most difficult issues for all dentists.^[15]

Consequently, Zheng et al. recently conducted a study. A total of 180 CBCT tests were split into 37/10/133 people at random for testing, validation, and training data, etc. Results indicated that human and automatic segmentation had considerable spatial overlaps in both training and validation sets (dice = 87.8%). A correlation coefficient of $r = 0.74$ indicated that there was no significant difference between the estimated and genuine human ages for the testing set ($p = 0.57$). This study found that the pulp chamber of first molars could be segmented from 3D CBCT images using an integrated DL and LS approach, and that the pulp chamber volumes that were obtained could be used to accurately estimate human ages.^[16]

CONCLUSION AND FUTURE RESEARCH

It is impossible to overlook the evolution of artificial intelligence, which has already started to demonstrate its benefits in dentistry. We have looked at the effectiveness of AI in endodontics. However, the sample data size is one of the main problems with the literature as it is now; larger sample sizes should be used in future research. Additionally, a few of models are not trained using pertinent clinical data, which renders their output unreliable regardless of what the accuracy meter indicates. There are currently not enough studies to draw firm conclusions about the useful application of AI technologies in everyday life.

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