Teeth, Tech, and AI: A Revolutionizing Approach in Dentistry

Abstract:

Introduction: Digital dentistry equipped with AI based integrated platforms enabled dentists to provide accurate diagnosis, prompt treatment, increased efficiency of evidence-based healthcare service provision.

Objectives:

- To explore the role of AI in dentistry with emphasis on public health aspects as oral health awareness, tobacco cessation counselling and tele Dentistry
- To reconnoitre the role of AI in dental healthcare services and public health surveillance.

Methodology: Electronic search in various databases with the keywords AI, Digital dentistry, oral health awareness, surveillance, Communication, Dental imaging, were performed such as PubMed/MEDLINE (National Library of Medicine), Scopus (Elsevier), Science Direct databases (Elsevier), Web of Science (Clarivate Analytics), and the Cochrane Collaboration (Wiley). 30 full-text articles were selected and systematically analysed and the relevant data were extracted.

Result and Conclusion : AI-driven platform enhanced oral health awareness, services and facilitated automated evidence synthesis in the field of dentistry making it affordable, accessible and available to the public. Integration of AI and digital dentistry holds the promise of revolutionizing the way we approach oral health care.

Key-words: AI, Digital dentistry, oral health awareness, surveillance, Communication, Dental imaging

Introduction:

The integration of digital technology and artificial intelligence (AI) has revolutionised the area of dentistry in recent years. The aforementioned advances have greatly improved patient care, diagnostic, and treatment outcomes in addition to streamlining conventional dentistry practices. Concerns about the long-term sustainability of healthcare systems are prompted by the ageing of the world's population and the rising demand for general and dental care.[1] Technology has facilitated remote consultations, electronic health records, Digital radiography and 3D imaging, precision medicine etc Technology integration has increased healthcare delivery efficiency while the potential for more innovation and a beneficial effect on healthcare outcomes remains tremendous as the technology develops.

Methodology:

Electronic search was conducted using databases such as PubMed, MEDLINE and Science Direct databases (Elsevier) and articles published in peer-reviewed journals followed by manual search of the reference list of included articles. Web-based search engines such as Google Scholar were also used to extract relevant articles using various keywords and their combinations such as AI, Digital dentistry, machine learning, deep learning, maxillofacial prostheses, Dental imaging, future dentistry. A total of 48 articles were obtained

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during initial search which was conducted keeping in view the papers published in the last few decades. However, after scrutinizing all articles, only 30 relevant articles were included in the final analysis and abstracts, and studies not in English or those whose full texts could not be retrieved were excluded.

Applications:

AI and diagnosis: Harnessing Artificial Intelligence for Precision Diagnosis

The cornerstone of any disease's efficient and successful management is an accurate diagnosis. Artificial neural network is the gold standard particularly where the aetiology of disease is multifactorial and complex.[2] The high specificity and sensitivity of ANNs are inferred when the diagnosis rendered by a dental surgeon are contrasted with the one acquired by ANN. It is also a valuable tool for early diagnosis and staging of oral cancer.[3]It may also be calibrated to forecast tooth surface loss and be used to predict the size of unerupted canines or premolars.[4]

AI and Radiology: Unleashing the Power of AI in Medical Imaging

Medical imaging segmentation can be automatically performed by AI, which improves image analysis and boosts radiologist confidence in diagnosis.[5] AIintegrated with Digital technology such as CT, MRI, CBCT can detect even the smallest variations from normal that are invisible to the human eye.[6] Also technologies like RVG helps in adopting a more sustainable approach.
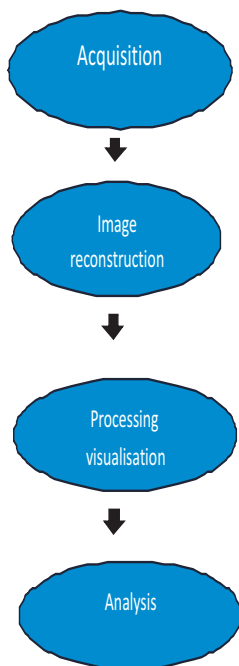
Navigating the Root Canals: AI Advancements in Endodontics

In identifying periapical radiolucencies on panoramic radiographs, a deep learning algorithm model can match the diagnostic performance of 24 oral and maxillofacial surgeons.[7]Examiner expertise plays a major role in the capacity to discriminate between periapical lesion detection on radiographs, as there are often significant discrepancies in this regard. By employing AI systems, bias and examiner discrepancies can be minimised.[8,9]ANN outperforms an endodontist in determining minor anatomic restriction.Following the instrumentation, the algorithm generated via AI and information analysis proven to be capable of measuring the root canal curvature and its three-dimensional alteration.[10]A VRF, which can be challenging to diagnose, may also be identified with the use of radiographs and CBCT imaging.

Orthodontics: transforming smiles through AI

An innovative development in the field of orthodontics is AI-driven customised orthodontic treatment which offers a more effective and individualised method of aligning teeth. artificial intelligence is employed at many stages of orthodontics, from diagnosis through treatment planning and follow-up monitoring. 3D imaging and high-resolution scans offer a precise and comprehensive depiction of the patient's teeth. Additionally, AI has enhanced the recognition of three-dimensional (3D) cephalometric landmarks.[11]substantial advances have been made in dental analysis through the use of 3D intraoral scanner images, digital dental models, landmark identification on teeth, and automated tooth segmentation using dynamic-graph convolutional neural networks (DGCNNs).[12,13] An increasing amount of research has been published on the use of AI to automate the assessment of skeletal maturity with the intent to increase clinical efficiency and reproducibility.[14,15] AI can also assist with treatment planning by anticipating changes in the teeth, skeleton, and face as well as the experience that patients will have with clear aligners.[16,17]

Prosthodontics and AI: Embracing AI for Enhanced Restorative Solutions

AI in dentistry has led to advancements in the precise fitting of prostheses using CAD/CAM technologies.[18]Implant dentistry has also adopted AI based digital technologies. Incorporating intraoral scans with cone-beam CT (CBCT) scans may contribute to highly successful dental implant treatment plans.[19] 3D models of a patient's teeth and jaws

can be produced using AI-powered imaging systems. Dentists may utilise these models to design intricate restorative procedures using 3D printing.

Surgical Intelligence: AI's Impact on Oral and Maxillofacial Surgery

The discipline of Oral and Maxillofacial Surgery (OMFS) is seeing a growing influence from artificial intelligence (AI), which presents creative ways to improve patient outcomes, treatment planning, and diagnosis.2D contour points detection photographs and 2D features contour correction images can becombined and texture mapped to create 3D models.[20]The CNN algorithm can also produce an accurate assessment of human age by eliminatinghuman simple mistake.

AI and Periodontia: Harnessing AI for Gum Health and Periodontal Care

Based on immune response profile, individuals with aggressive or chronic periodontitis can be successfully identified through ANN.AI has the potential of analysing radiographs to detect changes in periodontal and bone density.This may result in early intervention and improved therapeutic results. The procedure of periodontal charting, which entails measuring the attachment levels and pocket depths surrounding teeth, may be automated by AI. Automated charting solutions may improve precision, lower the possibility of human error, and expedite the documentation procedure.

AI Innovations in Public Health Dentistry: Transforming Oral Healthcare for All

Artificial intelligence contributes to the progress of preventive healthcare practices and the upholding of public health, as well as to the promotion of health. By utilising machine learning techniques for automated evidence synthesis and anomaly detection, health services may operate more efficiently, and public health surveillance can also be enhanced.[21]In situations where a dental health care professional cannot be reached, it may also offer emergency tele-assistance.In oral epidemiology, digital imaging can effectively reduce observer bias by enabling the remote scoring of anonymized pictures, thereby facilitating examiner blinding. multiple examiners at different sites may assess candidates simultaneously, which cuts down on training and calibration time and allows for uniform testing settings.[22]

For the purpose of detecting and staging a variety of oral conditions, there are numerous digital risk assessment models and screening tests available, including the Periodontal Risk Calculator (PRC), Electronic Oral Health Screening System (EOHSS), Caries Management by Risk Assessment (CAMBRA), Cariogram and CRAFT (Caries Risk Assessment for Treatment), and Risk Assessment-Based Individualised Treatment (RABIT). Metadata and Data Standards (MDDS) are the systems used to connect health providers at the state and federal levels, enabling smooth data and service exchange.[23,24]

Government of India has also taken many initiatives for the adoption of digital technology in healthcare such as National Health Policy (NHP,2017), NITI Aayog, Imaging biobank for cancer project (IBCP), National Digital Health Blueprint (NDHB, 2019). [25]

Health informatics and software applications such as SAS (Statistical Analysis System), EPI-INFO, and SPSS (Statistical Package for the Social Sciences) have facilitated huge data analysis and advanced epidemiological research.[26]

Discussion and limitations:

AI's contribution is instrumental in many areas such as accurate diagnosis and treatment of dental issues by utilizing dental radiographs and CBCT scans, orthodontics, implant placement, and customised prosthetic restorations based on patient data. AI-driven systems have boosted patients' involvement in oral health awareness. AI-driven chatbots and virtual assistants can also answer patient queries, send appointment reminders and post-treatment care instructions, enhancing patient engagement and satisfaction.[27] It also offers intriguing possibilities for enhancing surgical results in low- and middle-income nations that have a shortage of resources.

AI has certain limitations as well such as inappropriate data consolidation, lack of standardised method for data collection, inadequate training, expensive setup, limited explainability of AI algorithms especially deep learning algorithm, ethical issues etc.[28,29,30]
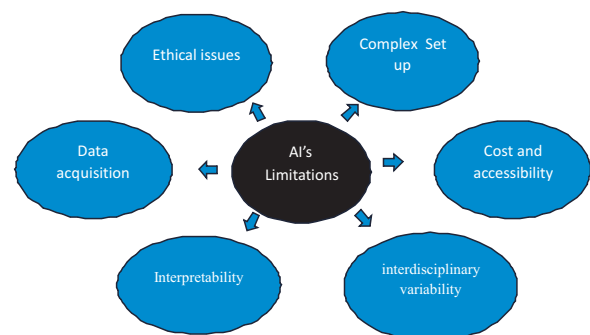
Therefore Prior to widespread adoption into clinical practice, high-quality evidence needs to be provided to assess the

usefulness of AI in terms of cost-effectiveness, dependability, applicability, and ethical and legal issues.

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