Guest Editorial

"Smarter smiles" – How artificial intelligence is revolutionizing dentistry

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A few years back reading about artificial intelligence (AI) in other industries made us wonder what impact it could have on dentistry and now we are witness to the precision and pronounced impact on our specialty, as someone who was trained predominantly in an analog environment, I have to accept that I took in the new advancements in AI with some sense of suspicion and curiosity. As Harvard Business Review aptly states, "AI is not coming for your job, but it will be your next coworker."[1] It is wise for us to stop debating if we are smarter or AI is, but to utilize the available tools to augment our specialty. It is to our advantage to embrace and integrate AI and newer advances so that our coming generation, the flag bearers can have a seat at the table.

AI has been extensively utilized for clinical administrative purposes and patient communication. AI-powered chatbots can help dentists communicate with their patients more efficiently and effectively. Patients can ask questions, schedule appointments, and receive reminders through a chatbot, which can free up staff time and improve the patient experience.

One of the most promising applications of AI is for diagnosis and treatment planning. A single radiograph may have multiple interpretations from different providers and the factors that influence it are human inconsistencies and training and clinical experience biases. Widespread inconsistency at the point of diagnosis means that patients are receiving different care depending on which dentist they happen to visit on that given day. That is an uncomfortable reality with serious implications for the quality and standard of care. Human inconsistencies are unpredictable and are a fundamental defect in dentistry and predictability is AI's strength. This can help dentists make more accurate diagnosis and develop a personal treatment plan for the patient.

In periodontics, accuracy of a diagnosis, risk, and prognosis may be improved by AI applied to images by developing a method that correlates a pattern in images to a similar pattern associated with a diagnosis, risk, or prognosis. AI has been used to determine clinical attachment levels and radiographic bone levels. However, some challenges are encountered in evaluating dental bitewings and periapical radiographs due to the limited field-of-view of these images. Deep learning models, another AI tool, have been developed to assist clinicians in interpreting and measuring alveolar bone, allowing for a more accurate and reliable periodontal diagnosis. Studies have demonstrated that a reliable periodontal diagnosis can be made based on interproximal bone level percentage and distance of each tooth measured by the deep learning model. Studies suggest the use of deep learning not only improves diagnosis accuracy but also significantly enhances clinical efficiency.[2]

In endodontics, AI tools have been useful for pretreatment diagnosis, precision of treatment, and post treatment analysis. An AI tool was successful in detecting 142 of a total of 153 periapical lesions and the reliability of correctly detecting a periapical lesion was 92.8% (ADA-43). Another area where AI has shown to help is in the detection of vertical root fractures. It is challenging to depict the precision as it also depends on the imaging. As we all are aware of imaging errors with different users and patient positions which can be mitigated with the use of AI-powered robots. Multiple imaging software have integrated AI to minimize errors. The next step is AI powered robots that can assist in dental procedures by holding instruments, taking X-rays, performing other tasks. This can help reduce the risk of human error. AI models (eg, convolutional neural networks and/or artificial neural networks) have demonstrated various applications in endodontics such as studying root canal system anatomy, detecting periapical lesions and root fractures, determining working length measurements, predicting the viability of dental pulp stem cells, and predicting the success of retreatment procedures.[3] By analyzing large amounts of data and identifying patterns and trends that may not be visible to the human eye, AI can help dentists make more accurate diagnoses and develop personalized treatment plans for their patients.

In oral and maxillofacial surgery, AI has been integrated in a variety of oral and maxillofacial surgery procedures, including orthognathic surgery, cleft lip and palate surgery, and oral cancer surgery. It has been noted that AI has the potential to improve surgical planning and intraoperative decision-making, as well as reduce the risk of complications and improve patient outcomes. AI algorithms can analyze 3D imaging data to create patient-specific surgical plans that take into account anatomical variations and potential complications. This can help surgeons perform procedures more accurately and efficiently, while minimizing the risk of post-operative complications. There is a potential of AI for assisting in robot-assisted surgery, which can improve the precision and safety of surgical procedures.[4] In addition, Operation Smile and Microsoft are developing a tool that uses AI to improve outcomes after a cleft lip operation. This technology uses standardized pictures of the patient before and after the procedure to grade the result and inform the surgeon whether the outcome was satisfactory or not.

Orthodontic care is increasingly using AI technologies for facial analysis, improving diagnostic accuracy, case design, and treatment planning. Scans, model design, and retainer construction are other areas where AI-supported technologies are changing the care pattern.

AI is a great tool to augment our specialty but is not a replacement for dental practitioners. AI cannot provide new insights but can provide predictability in our care. Quality of imagery is a major concern, as AI is based on specific data imagery. If imagery is taken by patients in their homes, the images of the extraoral and intraoral structures may be of poor quality, allowing for false-positive and false-negative results, which could be a hindrance to the dentist. It is due to this that doctors must understand the limitations of these AI systems and always know that they have the final say in the diagnosis. AI can help dentists make more accurate diagnoses and develop personalized treatment plans, but it cannot replace the human touch that is essential to patient care.

The scope of use of AI and augmented intelligence in the field of dentistry is limitless and we are eagerly awaiting to uncover the expansion of possibilities to all micro specialties in dentistry. AI's impact will extend to more advanced aspects of patient care, including fully automated smile design, higher quality, more durable restoration, and so on. It will also provide the opportunity to bridge skill gaps that exist between dentists. For example, some dentists may not be well versed in esthetic dentistry and some patients may not have access to quality dentists with expertise in the aesthetic field. AI can close the knowledge and skill gap and increase patient access to quality care by optimizing digital smile design tools and automating procedure and restoration planning. AI utilizes predictive analytics and helps predict patients who are at high risk for developing certain conditions such as caries and periodontal disease and allows dentistry to intervene early and focus on preventative care.

Moreover, the implementation of AI in dentistry will require significant investment in technology and training, as well as regulatory and ethical considerations which are all managed by the dentists. There are numerous ethical and risk assessment considerations such as data privacy, informed permission to use data, safety and transparency, and algorithmic fairness and biases.[4] We are still seeing the tip of the iceberg of AI utilization in dentistry and it will continue to add to our confusion and curiosity until we gather empirical evidence on the efficiency and efficacy of AI and augmented intelligence in our specialty.

In conclusion, AI has the potential to revolutionize dentistry by improving accuracy, efficiency, and patient outcomes. From diagnosis and treatment planning to patient communication, AI can assist dental professionals in providing better care for their patients. While further research and development will be needed to fully realize its potential, AI offers exciting possibilities for the future of dentistry.

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