

Implant Dentistry and Artificial Intelligence: A Double-Edged Innovation?

Implant dentistry, much like the rest of the dental profession, is being transformed by the various roles of artificial intelligence (AI). How substantial a transformation is it? That is to be determined. AI is being used in diagnostic systems, treatment planning algorithms, manufacturing, and business operations practices. There is also the potential to use AI for predictive modeling and differential risk assessments to identify higher-risk patients who may develop complications in the future.

Machine learning and various applications of AI have some obvious advantages, especially when used in cases including enhanced or augmented diagnostic accuracy (eg, radiographic images or early disease detection). I have seen recently where planning software is becoming more intuitive as predictive tools help, especially with the “segmentation” process of scatter plots that I have always found to be a pain. As an aside, at my dental school, we are now teaching AI-powered virtual reality and simulation tools to dental students such as ExoCAD, MeshMixer, and other related tools to create diagnostic “wax-ups.” Through this class topic, we are finding that the embedded AI tools help guide student learning. Chairside, while time will tell, combining imaging with biomarkers will always help to sufficiently identify early peri-implant disease and will show the provision of treatment options to the clinician. As mentioned earlier, we are already using AI at my college to automate routine administrative tasks such as patient appointment scheduling, revenue cycle management, patient reminders, meeting minutes, and various tasks that do not need a human to manage.

Yet there are challenges with rapidly evolving technologies. The obvious one I have seen with the university is the move to cloud-based storage systems to allow AI solutions. This raises complex patient data security and privacy issues, which can create complex legal risks for an institution. For instance, where is the data stored (or not), who has access, and who “owns” the data, especially if the university patient data has been used to train AI engines? At least in the United States, the final legal responsibility lies with the licensed provider. One cannot blame a tool for a complication when the user did not understand the assumptions the tool was making. This does raise the interesting question of vicarious liability because lawyers often sue all parties involved in a complication, and it would be interesting to see if medical liability laws will change to address lawsuits

against AI systems. I realize we sign disclaimers when using software, but vicarious liability is used to work around these limited liability contracts. Only time will tell what impact AI will have.

Another issue that could be a problem is excessive dependence on AI tools that could erode clinical diagnostic skills among practitioners. AI algorithms are also only as good as the data they are trained on. Thus, biased or limited-input datasets can result in flawed analyses or hallucinations leading to misdiagnoses or inappropriate treatment plans.

AI does have great potential in the mutual evolution of its capabilities with implant dentistry, providing great opportunities in clinical care, education, and research. Because of predictive modeling in image datasets (facial imaging, intraoral scanners, and next-generation CBCTs), we have the potential for enhanced precision in implant site development and placement and hopefully better long-term outcomes. There is also a great opportunity to combine AI diagnostics with care delivery using the developing generations of navigational surgery and robotics.

The key to leveraging the advantages of innovations lies in “balanced integration,” continued professional education and training, regulatory oversight, and patient education. As technology continues to advance, we need an ongoing collaborative approach between clinicians, engineers, and ethicists. It is essential to ensure that these tools can enhance the human heart rather than replace it, as that is at the heart of dentistry.

Regards,



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