

Egyptian Prosthodontic Association (EPA Newsletter)

Artificial Intelligence (AI) Applications in Fixed Prosthodontics Future Perspective



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Introduction To Artificial Intelligence.

AI is modern technology based on replicating human intelligence and activities with the help of computer algorithms. It is a form of a data-driven mathematical model. The model is trained on the previously available data, which enables the capabilities of predictions. The digitalized data is increasing day by day in the present time and helps in the training of AI models to generate more accurate results. AI model is similar to the neural network of the human body. Also, the model is referred to as ANN, which stands for an artificial neural network ⁽¹⁾.

Layers of ANN Model

AI model consists of mainly three layers. **The first layer** is the input layer from which parameters are given in the model. The **second layer** is referred to as the hidden layer consisting of neurons. **The third layer** is the output layer. In the process of training, the model is provided with training data. This data helps the model to establish a mathematical relationship in the input and output parameters. This trained model is further optimized on the testing dataset for more accurate results. Once the model is completely

optimized, it is ready for practical predictions (Figure 1).

AI is highly dependent on datasets. These datasets should be appropriately classified and filtered for excellent model training⁽¹⁾.

AI applications in Fixed prosthodontics.

1- CAD/CAM Applications.

In digital fixed prosthodontics era, margin detection can be completed using AI following an intraoral scan either for fixed restorations created on prepared teeth or on implant abutments⁽²⁾. In case of implant supported restorations margin detection as errors in subgingival margin detection and restoration fabrication can lead to serious biologic problems around implant fixtures⁽²⁾.

AI models can help to fabricate restorations with accurate occlusal and proximal contacts, which helps to reduce errors and time required for intraoral adjustment of restorations.

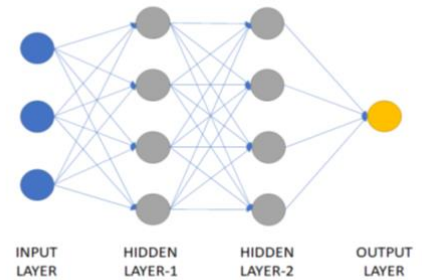


Figure (1): Scheme for ANN model.

2- Diagnosis and treatment planning.

Recent systematic review revealed that AI systems currently can be used for diagnostic purposes, especially in dental imaging and radiology⁽³⁾, and also are used as classification tools for periodontally compromised teeth, dental cusps, or caries. AI models can also help to identify restorability of endodontically treated teeth with ability to identify vertical root fracture from CBCT⁽⁴⁾. Encouragingly, studies reported high performance of the different AI models in diagnostic accuracy for detection dental caries⁽⁵⁾, and very good prediction accuracy for debonding of CAD/CAM crowns⁽⁶⁾.

3- Detection and classification of implant systems from radiographs.

Some cases of implants that require repair or remake of implant supported restorations are quite difficult, this is due to unknown implant system, which makes it a difficult mission for taking impression and selection of abutments. Recent deployment of a convolutional neural network (CNN) was used to identify and classify with high accuracy unknown implants systems with the help of panoramic and periapical radiographs⁽⁷⁾.

4- AI for detection of facial landmarks and smile design.

Digital smile design (DSD) technology, which takes pictures of patients' faces together with anterior dentition and uses them for prosthesis design, is now widely used in the field of esthetic dentistry. However, the limitation of DSD is that it evaluates a patient with only one photograph taken in a still state, and the patient's profile cannot be observed from various viewpoints. AI trained models can be used segment the patient's anterior teeth, gingiva and facial landmarks (Figure 2).

Future of AI

AI is changing everything from space research to dentistry. Biomedical diagnosis, therapy planning, patient recording, and management have several benefits. AI aids physicians and patients in every profession, and in the future, AI will produce a forecast that can be merged with human diagnosis to increase the chances of appropriate diagnostics, leading to a higher rate of correct diagnoses. Despite the encouraging outcomes, it is still important to validate the generalizability and reliability of the provided AI models using adequate external data acquired from newly enrolled patients or gathered from other dental facilities. There will be a significant need for

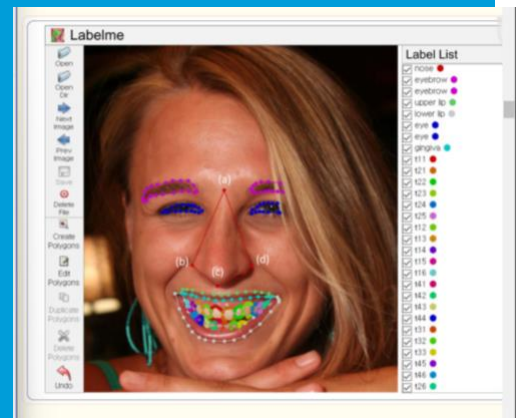


Figure (2): Detection of facial landmarks using AI model.



AI-enabled algorithms as CAD/CAM technology advances and prosthodontic implant procedures require more accuracy.⁽⁹⁾





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