



ORIGINAL RESEARCH PAPER

Prosthodontics

SCOPE OF ARTIFICIAL INTELLIGENCE IN PROSTHODONTICS – A REVIEW

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ABSTRACT

Artificial intelligence (AI) is the data-driven disruptive technology of modern times. AI is reforming every field from space science to dentistry. Bio-medical provides various advantages over conventional diagnosis, treatment planning, patient documentation and management. AI is a technology that uses machines to imitate intelligent human behaviour. AI is gaining popularity worldwide because of its significant impact and breakthrough in the field of intelligence innovation. It is a lifesaver in dentistry, particularly in the field of prosthodontics, because it aids in the design of prostheses and the fabrication of functional maxillofacial prosthesis. This is a review article about the scope of Artificial Intelligence in Prosthodontics.

INTRODUCTION

Prosthodontics is one of the branches of dentistry, mainly deals with replacement and rehabilitation of missing teeth with the help of fixed and removable prosthesis or with biocompatible substitutes like implants. In addition, it also helps to restore proper soft and hard tissues of the mouth, thereby improving the overall health status of the oral cavity.

- The importance of fabricating the dental prosthesis are,
1. Compromise on the physical, mental and emotional health due to missing tooth structure. This absence creates problems related to chewing capabilities (or mastication), which eventually results in avoiding and altering an individual's food habits.
 2. Lack of teeth results in isolation due to fear of social acceptance. Since every individual desires proper aesthetics for every part of body and teeth with its associated soft tissue, it plays an essential role in socializing.
 3. The presence of teeth in the oral cavity helps maintain proper tongue position and placement of lips and cheeks, thus imparting suitable shape to the facial structures.

Edentulous spaces, replacement of lost hard and soft tissues, aesthetics, function and support of the orofacial structures, interim prosthesis are few indications for using partial dentures in adults. Besides the outcome of prosthesis, fabrication of dentures also determines the prognosis of residual ridge and abutment teeth. Essential functions such as mastication, swallowing, cognitive functions and pronunciation also depend upon dental prosthesis design.

Artificial Intelligence [AI] is described as “a branch of science and engineering concerned with the computational understanding of what is often referred to as intelligent behaviour and the development of artifacts that display such behaviour. A specific algorithm was established with the vast amount of data available which further aided in diagnosing and providing probable treatment alternatives. It has the potential to be used in prosthodontics for condition analysis and treatment planning.

Artificial Intelligence [AI] in prosthodontics

Prosthodontics is primarily concerned with the treatment and fabrication of removable and fixed dental prostheses, as well as the preparation of finishing margins alongside the tooth for better extension and fitting of the prosthesis, implant surgery, and the construction of a maxillofacial prosthesis. It is also used for maintaining maxillomandibular relations and tooth shade selection for improved appearance.

Hong et al conducted a study with the deployment of a convolutional neural network (CNN) from deep learning for determining the efficacy of CNN models to classify the implants with the help of panoramic and periapical

radiographs. From the results of this study, it can be concluded that the deep CNN model can be a helpful aid in classifying implant systems with almost equal or greater accuracy compared to humans.

Henriette Lerner et al conducted study with zirconia implant prosthesis in posterior teeth. The promising results were observed with the usage of AI model. This AI model was to help in the fabrication of fixed implant prosthesis using monolithic zirconia crowns. The deployment of the AI model to assist in the detection of subgingival margins of the abutment. Also, this model helped in increasing the dentist's focus on tooth preparation and maintaining interproximal and occlusal contacts.

Zhang et al conducted a deep learning model study to extract marginal line with precision. This study included 380 dental preparation models. Sparse octree (S-Octree) was used as a CNN model to extract the data. Sparse point cloud with the labels was made with the help of the processing of dental preparations. Eighth depth octree structure was developed for the study. The data was divided into training, verification and test data sets. CNN models were trained by marking the labels on dental preparations. In the study, back projection and boundary extraction methods were implemented, tooth preparation line was extracted that overcomes the disadvantages of manual practice. The average accuracy reached up to 97.43%. This higher accuracy showed the capabilities of AI for overcoming manual errors made it a good option for implementation.

Takahashi conducted a study to develop an AI model with the help of CNN for classification of dental arches to assist in the fabrication of dentures. Data used for the study was collected in the form of oral photographic images, 1184 of total including 748 of the maxillary arches and 438 of the mandibular arches. Types of arches included complete edentulous, arches with posterior tooth loss, bounded edentulous space and intact arch. The data set was divided into training data set with 1016 images (85%) and testing data set with 168 images (15%). TensorFlow and Keras were used for the development of the CNN model. With the help of autonomous learning procedures by computer, classification of training data set was done based on learning. Prediction of dental arches was made after the learning procedure was completed. Values indicated that there was a future possibility of AI models to assist the clinicians in classifying arches and thus help high-quality design RPD for each patient.

Limitations

Artificial Intelligence [AI] aids in making of logical and realistic conclusions, resulting in an accurate diagnosis. Although there are certain drawbacks to applying AI in

dentistry, such as system complexity, trained experts and costly setup. Data is usually used for both training and testing, which leads to data snooping bias.

CONCLUSION

Artificial Intelligence[AI] in prosthodontics is expanding at an exponential rate. The outcomes of the implementation are comparable to, and occasionally better than, those of humans. Artificial Intelligence can be viewed as a possible tool in every aspect, such as classifying denture fixtures, maxillofacial prostheses, extracting marginal lines and reducing human error in implant cementation.

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