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Editorial

Artificial Intelligence in Planning Oral Rehabilitations: Current Status

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Diagnostic digital 3D images, such as cone-beam computed tomography (CBCT) and magnetic resonance imaging (MRI), have been widely evaluated quantitatively and qualitatively regarding their diagnostic performance for identify various alterations. Digital 3D methods for imaging acquisition have also been used along with computer-aided design and computer-aided manufacturing (CAD-CAM) for several clinical applications in oral rehabilitation [1,2]. The current advantages of these methods compared to the traditional analogous ones have been described in a previous Editorial published in this journal [3]. In general, digital workflow in dentistry enhances predictability and some of the clinical outcomes, such as dental prosthetic adaptation and trueness, with shorter total treatment times [1]. In this context, artificial intelligence (AI) algorithms have been used to further orient dentists regarding the diagnosis and prognosis of several types of clinical situations [4–15].

The concept of AI has generally been defined as the technology required for a machine to perform tasks that usually require human intelligence. To date, dental treatments have used weak AI, which is the one used for simple tasks and the recognition of objects. Among the main AI methods used in dentistry is machine learning, which was further developed to deep learning and neural networks. The latter, in turn, was also upgraded to convolutional neural networks, which require less training data, for instance, to recognize alterations or features in an image [1].

Among the main clinical diagnostic applications of AI described in dental research are the detection of anatomical structures [2], caries [4], periapical lesions [5], periodontal bone loss [6], root fractures [7], odontogenic tumors [8], and even malignant diseases [9]. Furthermore, AI has been used to predict periodontal prognosis [10], need of orthodontic treatment [11], and debonding of resin composite crowns [12]. These studies generally presented favorable or promising results and accuracy levels using either optical or radiographic images as training data.

Another important group of applications of AI in dentistry that is becoming a focus of current research is the use of automated software features for decision making and dental treatment planning [13]. Since oral rehabilitations conducted with digital workflows are usually prosthetically driven, automated tooth segmentation as well as the design of crowns and fixed bridges should receive special attention from clinicians, due to a clinically relevant potential of expediting virtual waxing procedure with a satisfactory outcome [14]. In esthetic areas, automated tooth-shade-matching tools could also become important for dental prosthetic planning [15]. However, the aforementioned study found discrepancies between the method involving AI and traditional clinical shade matching.

In image guided-implant surgery, AI can be used to export Digital Imaging and Communication in Medicine (DICOM) files from CBCT as high-quality Standard Tessellation Language (STL) files of 3D-reconstructed models with optimized threshold levels that eliminate undesired artifacts [2]. This, in turn, enables practitioners to carry out adequate alignments and superimpositions between CBCT and intraoral scans, which are very important for implant surgical planning, since the conditions of both hard and soft tissues will

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affect implant placement and even bone graft procedures. These surgical plans should also be prosthetically driven, emphasizing the importance of software knowledge if a digital workflow is being used. It is also noteworthy that a series of AI algorithms are already present in CAD-CAM systems [1].

In conclusion, it is therefore suggested that AI has the potential to facilitate and expedite the treatment planning of oral rehabilitations, regardless of whether surgical procedures are required or not. Nevertheless, clinical decisions during treatment planning should still be based on scientific evidence and on accepted theories, such as the principles of occlusion. The control and responsibility over these clinical decisions during oral rehabilitations still belong to dental professionals, who should have increased software-specific knowledge in order to take advantage of the digital workflow as well as AI features and tools to their full extent. Finally, one should also recognize that the research on AI in dentistry is still most likely in its early stages.

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