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Artificial Intelligence in Prosthodontics - Enhancing Applications and Performance.

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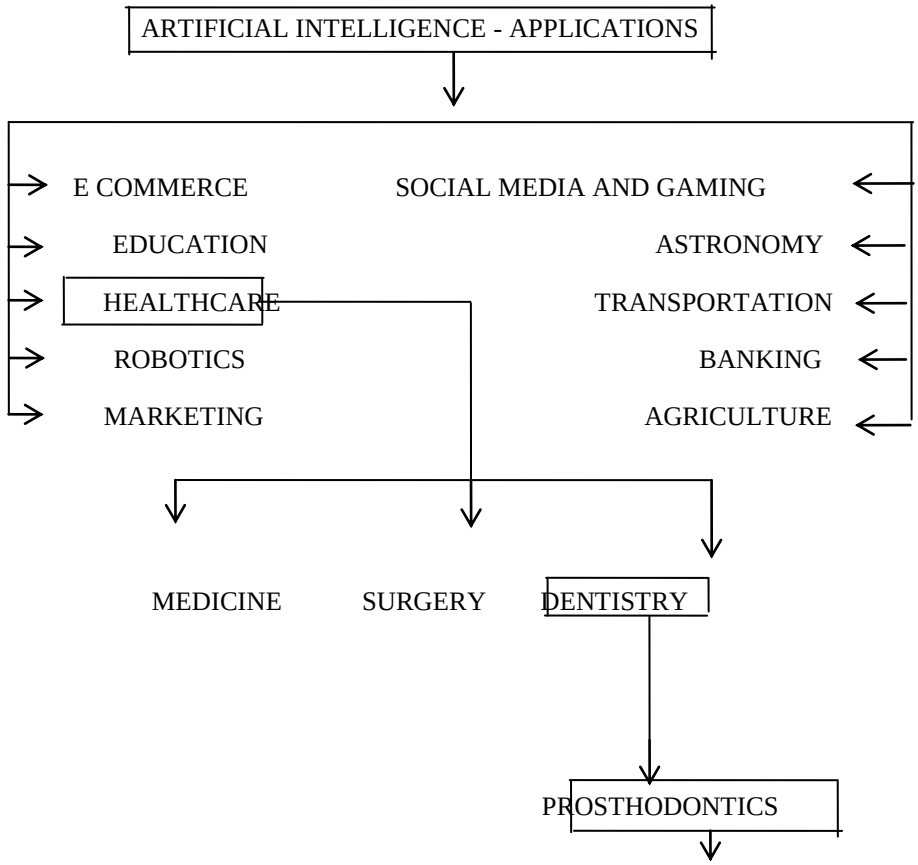
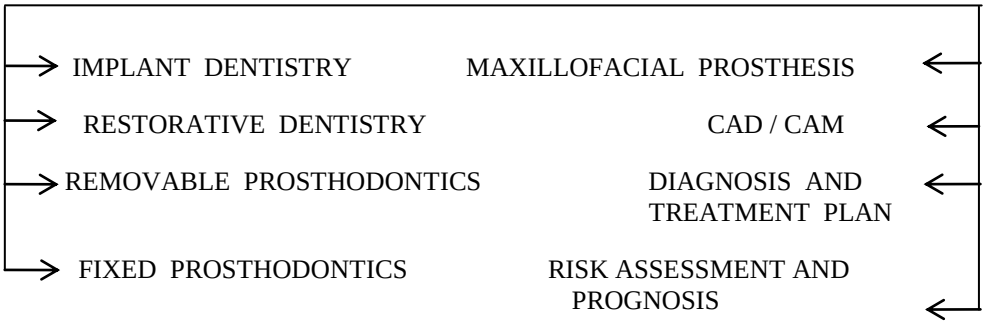
Abstract: *This review explores the integration of Artificial intelligence in the field of Prosthodontics, mainly focusing on it's applications and performances in the fixed Prosthodontics. AI is a technology which is designed to imitate the human behaviour. It has become the life saver in the field of dentistry, especially in Prosthodontics. It aids in the design of prosthesis and in the fabrication of other maxillofacial appliances.This article gives an overview of all the applications of AI in fixed Prosthodontics along with it's future scope.*

I. Introduction

Applications and performances of artificial intelligence are increasing in Prosthodontics. It is a branch of computer science,concerned with building smart machines capable of performing tasks which requires human intelligence. AI reduces the workload of the dental healthcare professionals, and also the need for more staff.[1] AI can be utilised in the field of Prosthodontics, Orthodontics, Surgery, and Periodontics for providing potential treatment plans.[1] It helps in improving the success rate of all procedures, and enhance the efficiency,accuracy and effectiveness of Prosthodontic treatments. The applications of AI including the CAD/CAM systems plays an important role in prosthetic dentistry. Intraoral scanners, CAD/CAM technology and AI have made the processes faster and improved the quality of the prosthesis. We can use AI to ensure quality treatment, better prognosis and to achieve precision.

II. Applications of AI





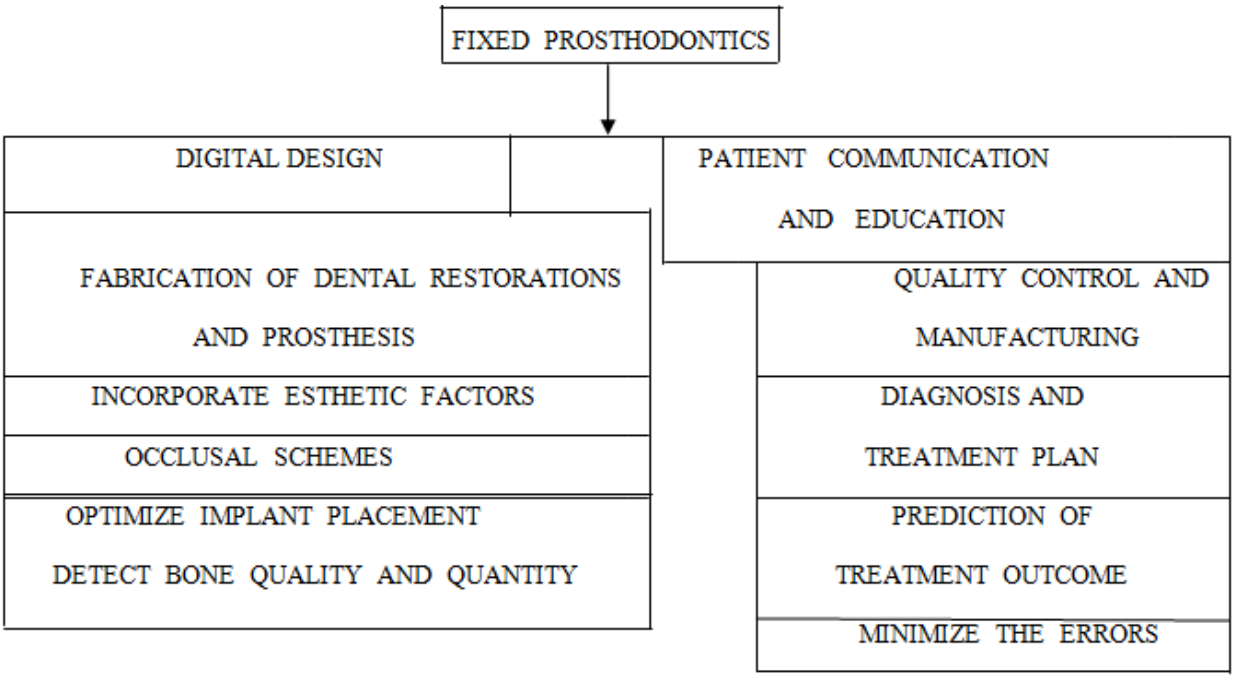
III. AI in prosthodontics

AI assists in many aspects of Prosthodontics, such as diagnosis, treatment planning and rehabilitation.[11] It is used to create 3D models of teeth and jaws that can be used in the fabrication of crowns and bridges. It aids in the correction of any issues in the prosthesis and improves patient's satisfaction.

* It helps in the design and fabrication of RPDs (Removable partial dentures) ,leading to efficient treatment options for partial edentulous patients.[1]
* AI models are used in tooth shade selection leading to better shade selection than with the conventional visual selection.[2]
* AI models in automated designing of dental restorations, optimising manufacturing casting processes also plays an important role.
* AI is used in the fabrication of implant supported crowns such as MZCs (monolithic zirconia crowns) for the restoration of single implant .[3]
* AI is used in fixed Prosthodontics that helps to improve the efficiency of tooth preparation.[1]
* AI in maxillofacial prosthesis uses convolutional neural networks (CNNs) to mimic the human neurons and prosthetic devices that is used in patients with any maxillofacial injuries or abnormalities.[1]

IV. Applications of AI in fixed prosthesis

* AI provides successful crown designs, providing optimal contour, marginal line and extension .[1]
* It detects the marginal bone loss (MBL) around the fixed prosthesis.[5]
* It manufactures single - implant monolithic restorations , with improved quality and esthetics.[6]
* CAD/CAM fabricates tooth coloured glass ceramic crowns, all ceramic crowns, and bridges with zirconia based frameworks.
* It aids in selecting the most suitable materials and designs and streamlines the process based on the digital scans of dentition .
* AI assists in the tooth margin preparation process by automation , whereas traditional method required more technical skills and more time consuming.[1]
* In the field of implant dentistry, it merges the intraoral scanning and cone beam computed tomography (CBCT) to develop advanced prosthetic solutions.[1]
* It predicts the success of different types of dental implants and any postoperative discomfort or fractured implants.[4]



V. Performance of AI in fixed prosthesis

* Intraoral scanners are used regularly for the fabrication of one crown or short span Fixed partial denture .[7]
* AI models can locate the critical anatomic landmarks and measures bone dimensions in implant planning .[4]
* AI models and algorithms can design the required prosthesis by analysing the patient's anatomical scans and data.[1]
* It has the tendency in repeating the tasks in design process which is time consuming.[8]
* It suggests any modifications or requirements needed in the previous successful prosthesis based on patient's needs,for improvement in the future design .
* It can remake the design / prosthesis by detecting any flaws .[9]

VI. CAD/CAM procedure : (For dental restorations)

TAKE A DIGITAL / TRADITIONAL IMPRESSION

↓

CASTING STONE MODEL AND SCANNING

↓

DESIGNING THE DENTAL RESTORATION **{CAD}**

↓

SELECTION OF APPROPRIATE MATERIAL / BLOCKS

↓

PLACING IN THE MILLING MACHINE

↓

FABRICATION OF THE FINAL RESTORATION **{CAM}**

CEMENTATION AND PLACEMENT OF RESTORATION

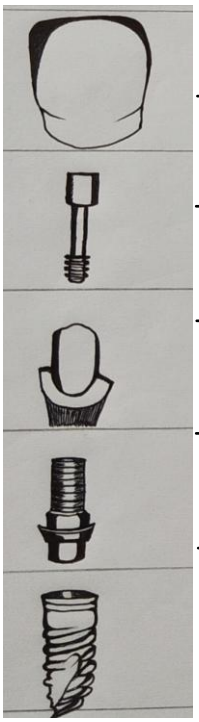


Figure 1. PARTS OF FINAL RESTORATION.

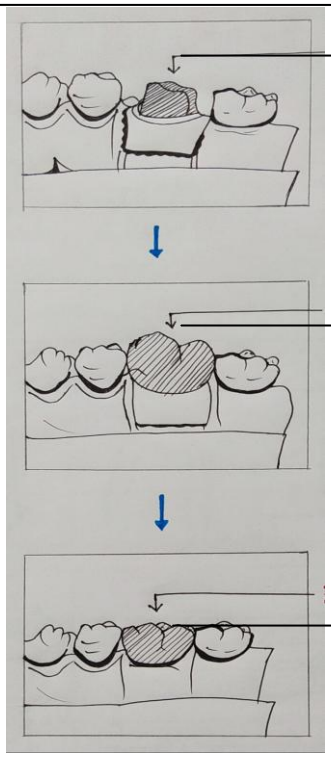


Figure 2. CROWN DESIGNING

VII. Materials used in CAD/CAM

Different cad/cam systems use different types of materials.

* Ceramics such as ,infiltrated ceramics, silica based ceramics are the widely used materials.
* Metals (Cobalt chromium, titanium) , resins and waxes may also be used in this technology.
* Ceramic materials are available as mono-chromatic or poly-chromatic blocks.
* Examples of dental ceramics are:- CEREC, IPS EMPRESS CAD CAM, IN CERAM ALUMINA / ZIRCONIA, VIRABLOCKS MARK II ,etc.

Figure 3. SCANNING THE MODEL

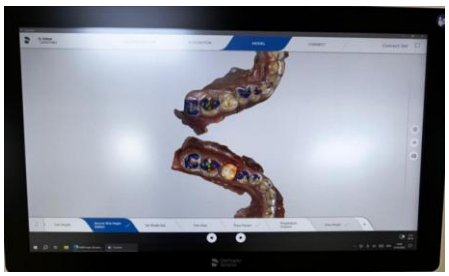


Figure 4. PRIMESCAN INTRA ORAL SCANNER

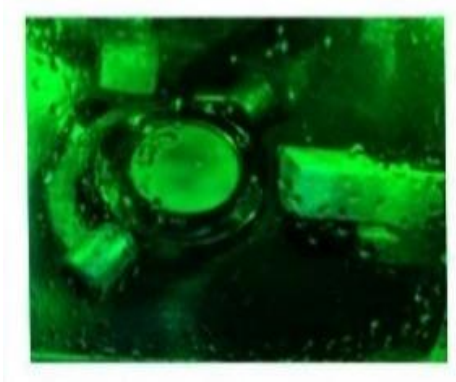


Figure 5 MILLING OF THE PROSTHESIS

Figure 6.FINISHED PROSTHESIS

VIII. Future scope

AI definitely has further scope in future, there are many developments of AI coming up in the field of dentistry. Though it is still under development ,it has good scope in the art models which enhances dentistry. There are many articles and some books which are coming up with the information of AI in dentistry ,which each and every future dentists has to be educated about . It is an educational tool to guide the dental students to make them practice all the procedures ,before working on the patients. There can be many advancements of AI in the future and it creates a wide variety of opportunities for dental graduates in clinical practice.

IX. Conclusion

To conclude , we know that AI has revolutionized in the field of dentistry by many advantages, such as precision, accuracy,time saving, patient's satisfaction and economical for practitioners etc.[10] AI has to be applied professionally in all the institutes and health care centres due to it's several advantages. It has the potential to change the entire dental profession. It not only satisfies the patients ,but also satisfies and reduces stress to the doctors/dentists due to easy workability. It is cost effective and has introduced newly modified dental materials with better strength and other qualities .It requires skillfull technicians ,dentists and the assistants for the correct processing. This should be ensured before initiating the AI technology. But there are certain limitations in it's practical applications, which requires further studies / research to ensure the effectiveness of AI. Whereas ,the advancements of AI has enlightened it's use in the field of dentistry . Finally we also need to remember that AI is a powerful tool required to empower the dentists and technicians, but not to

replace their skills / expertise ,as it is nothing without human intelligence, with a proper balance between human expertise and reliance on technology.[12]

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