

 <p>ISSN NO. 2320-5407</p>	<p>Journal Homepage: - www.journalijar.com</p> <h2>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)</h2> <p>Article DOI: 10.21474/IJAR01/8242 DOI URL: http://dx.doi.org/10.21474/IJAR01/8242</p>	 <p>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR) ISSN 2320-5407 Journal Homepage: http://www.journalijar.com Journal DOI: 10.21474/IJAR01</p>
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RESEARCH ARTICLE

ARTIFICIAL INTELLIGENCE IN DENTISTRY: CURRENT CONCEPTS AND A PEEP INTO THE FUTURE.

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Manuscript Info

Manuscript History

Received: 18 October 2018

Final Accepted: 20 November 2018

Published: December 2018

Keywords:

Artificial Intelligence, Virtual Reality,
Clinical Decision Support System,
Augmented Reality.

Abstract

The last decade has marked the evolution of artificial intelligence which has been ushered in with tremendous hype and enthusiasm and dentistry is no exception. The tremendous amount of patient data requires intelligent software for computation. In dentistry artificial intelligence holds lot of importance including patient diagnosis,storage of patient data,assessment of genetic information which will provide better health care for patients. The robotic surgery techniques have made a big impact in surgery. Artificial intelligence helps dentists in providing better orthodontic and prosthodontic treatment. Inspite of these many advances ,artificial intelligence is still in its teething stage but the potential is unlimited.

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Introduction:-

The human brain is one of the most intriguing structures in the human body which has made scientists and researchers inquisitive from time immemorial .A perfect model mimicking the human brain has always remained an enigma for the scientific community [1].Aland Turing, a young British polymath explored the mathematical possibility of artificial intelligence and devised the Turing test to suggest that machines can use available information and reason to solve problems like humans [2]. The term artificial intelligence was coined by John McCarthy in 1956.Constant search for the model has led to the development of artificial intelligence which is defined as a field of science and engineering concerned with the computational understanding of what is commonly called intelligent behavior and with creation of artifacts that exhibit such behavior[1]. Artificial intelligence project intelligent systems that are able to experience their own environment and the measures to maximize their own chances of success [3].Artificial neural networks simulating the neural signal transmission and the human brain are an essential part of artificial intelligence .Programming languages of Artificial intelligence are the principal tools in understanding these symbolic information [4].The paper aims to provide an insight into the current concepts and the likely future prospects of artificial intelligence in dentistry.

Artificial Neural Networks:-

Artificial neural networks are developed based on brain structure and like the brain they can recognize pattern, ,manage data and learning. The most important advantage of artificial neural networks is that this kind of system solves problems that are too complex for conventional techniques and those that do not have an algorithmic solution or the solution is too complex to be used.They are used in various areas of medicine such as diagnostic systems

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,biomedical analysis ,image analysis and drug development[5] .In 1957, Frank Rosenblatt invented the perception algorithm which was designed for image recognition .It had an array of 400 photocells randomly connected to “neurons”. Weights were encoded in potentiometers and weight updates during learning were performed by electric motors [6]. Back propagation learning was proposed by Paul Webros in 1974. It is a method used in artificial intelligence to calculate a gradient that is needed in the calculation of the weights to be used in the networks .It is commonly used to train deep neural networks a term referring to neural networks with more than one hidden layer. This is used by health professionals to diagnose the disease early and to communicate with fellow professionals worldwide to give more effective treatment for the patient [7].

Augmented and Virtual Reality:-

Augmented reality is an interactive experience of a real world environment where the objects that reside in the real world are augmented by computer generated perceptual information sometimes across multiple sensory modalities including visual, haptic ,olfactory and somatosensory[8]. The overlaid sensory information can be constructive or destructive and is seamlessly interwoven as an immersive aspect of real environment[9]. Augmented reality has a lot of applications in laproscopy as well as plastic and neurosurgery. In oral and maxillofacial surgery ,augmented reality has applications in implantology and orthognathic surgery. It has applications in endodontics, orthodontics and restorative dentistry[10].

Virtual reality is a computer generated simulation of a three dimensional image or environment that can be interacted in a seemingly real or physical way by a person using special electronic equipment. In dentistry, virtual reality can serve as an effective non pharmacologic analgesic for dental pain[11]. Virtual reality has been shown promise in training dental students. Le Blanc et.al in their preliminary study in using virtual reality to train dental students between 6 to 10 hours a day showed significant improvement in their performance [12].

Clinical Disease:-

Support System (CDSS):-

The Decision Support System (DSS) which supported only the financial or administrative domain has been replaced by Clinical Disease Research System (CDSS). CDSS aims to create computer programmes to simulate the human thinking by using machine techniques. The machine learning algorithms heavily rely on available data from previous observations which include information provided by physician, pharmacists and other health care individuals [13]. The main objectives include documentation and clinical coding, organizing clinical complexity, storing and maintaining patient databases, tracking patient orders, monitoring health condition as well as a preventive measure. CDSS thus provides information to medical personal, patients or individuals or populations to produce faster, more efficient and better health outcomes for both individual health services and health of population in general [14].

Applications of Artificial Intelligence in Various Fields of Dentistry:-

Artificial Intelligence in Patient Management:-

Artificial intelligence based virtual dental assistants can perform several tasks in the dental clinic with greater precision, fewer errors and less manpower compared to humans. It can be used to coordinate appointments, managing insurance and paperworks as well as assisting clinical diagnosis or treatment planning. It is very useful in alerting the dentist about patients medical history as well as habits like alcoholism and smoking. In dental emergencies, the patient has a option of emergency teleassistance especially when the practitioner is unavailable [15]. Thus a detailed virtual database of the patient can be created which will go a long way in providing ideal treatment for the patient [16].

Artificial intelligence in Diagnosis and Treatment:-

Artificial intelligence can be used as a useful modality in diagnosis and treatment of lesions of oral cavity and can be employed in screening and classifying suspicious altered mucosa undergoing premalignant and malignant changes. Even minute changes at single pixel level which might go unnoticed by the naked eye are detected. Artificial intelligence might accurately predict a genetic predisposition for oral cancer for a large population [17].

Artificial Intelligence in Oral and Maxillofacial Surgery:-

The greatest application of artificial intelligence in oral surgery is the development of robotic surgery where human body motion and human intelligence is simulated [18]. Successful clinical application in image guided surgery in cranial area include oral implant surgery, removal of tumor and foreign bodies, biopsy and TMJ surgery [19].

Comparative studies in oral implant surgery indicate significantly more accuracy compared to manual freehand procedure even if performed by experienced surgeons. In addition no significant difference between experienced surgeon and trainees were found [20]. Generally shorter operation time, safer manipulation around delicate structures and higher intra operative accuracy has been reported. Image guidance allows more thorough surgical resection potentially decreasing need for revision procedures [21].

Artificial Intelligence in Prosthetic Dentistry:-

In order to provide ideal esthetic prosthesis for the patient various factors like anthropological calculations ,facial measurements, ethnicity and patient preferences has been integrated by a design assistant,RaPid for use in prosthodontics .RaPiD integrates computer aided design, knowledge based systems and databases ,employing a logic based representation as a unifying medium[22].CAD/CAM (Computer aided design/Computer aided manufacturing) application in dentistry is the process by which is attained finished dental restoration through fine milling process of ready ceramic blocks. It is used in manufacture of inlays, onlays, crowns as well as crowns and bridges.CAD/CAM technique essentially creates a two dimensional and three dimensional models and their materialization by numerically controlled mechanics. It has replaced the time consuming and laborious process of conventional casting and reducing the human error component in final prosthesis[23].

Artificial Intelligence in Orthodontics:-

Diagnosis and treatment planning can be one by analysis of radiographs and photographs by intraoral scanners and cameras [24]. This eliminates the necessity for making patient impression as well as several laboratory steps and the results are usually much more accurate compared to human perception. The tooth movement and final treatment outcome can be predicted by using algorithms and statistical analysis [25].

Conclusion:-

There is tremendous potential for research in artificial intelligence in medicine and dentistry. The research should be integrated with clinical practice for better results. Even though advanced sign natural language processing ,image recognition ,neural networking and speech recognition are on the anvil the high initial costs can often be a deterrent. Artificial intelligence can certainly be tool in making significant progress in delivering better health care to the patient but in no way can replace human knowledge, skills and power of judgement.

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