DENTISTRY IN THE REALM OF METAVERSE-A REVIEW

Dentistry

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ABSTRACT

The metaverse is a virtual world where users can interact with 3D objects using many senses to mimic the natural world. Stated differently, the metaverse ecology might be thought of as a twin world or 3D simulation.The application of digital workflow to our practice and the educational setting has proven its efficiency, as demonstrated by the reduction of waste and time, increased cost effectiveness, reduction in the time and number of appointments, improvement in predictability through improved treatment planning, and improved patient satisfaction. We have previously witnessed the introduction of digital technologies to reconstructive dentistry, implant dentistry, aesthetic dentistry, orthodontics, etc. The marketing potential of dental offices' metaverse presence can be advantageous. There are countless options with increased accessibility, fewer travel expenses, and the advantage of switching between sessions or booths from any location in the globe. These include providing dental care to the impoverished and leveraging technology advancements to improve training models.The following review is an encouraging example that demonstrates the potential for the use of metaverse modalities in the advancement of contemporary dentistry.

KEYWORDS

INTRODUCTION

American author Neal Stephenson's science fiction book Snow Crash introduced the idea of the metaverse for the first time in 1992. The characters in Snow Crash transform into avatars and operate in a 3-dimensional (3D) virtual world known as the metaverse[1]. The term "metaverse" describes a virtual reality that exists outside of reality. Its root words are "meta," which denotes transcendence and virtuality, and "universe," which denotes the world and the cosmos. In other terms, the twin world or 3D world simulation that makes up the metaverse ecology.[2]

We have already seen that introduction of digital technologies in various fields of dentistry like prosthodontics , aesthetic dentistry, orthodontics. The implementation of the digital workflow to our practice and the educational setting has proven its efficiency, such as a reduction in waste, time, increased cost effectiveness, reduction in number of appointments, and increase in predictability through improved treatment.[3] Recent advancements in artificial intelligence (AI) and augmented and virtual reality (AR/VR) have made it easier to diagnose clinical conditions, arrange therapy for patients, and facilitate dental students' learning. These tools could, in fact, make it easier to apply evidence-based practices. The rapid development and acceptance of teaching tools in dental education, such as the flipped classroom , were also aided by the coronavirus epidemic . There is a huge need for online programs to educate people about dental health.[4]

Blockchain serves as the metaverse's foundation, highlighting the fact that it is decentralized and does not rely on a third party for its operation . Thus, the adoption of blockchain technology in the healthcare sector has become a promising element with the rise of cryptocurrencies. Other metaverse-related modalities, such as non-fungible tokens (NFTs), have the potential to revolutionize society. As a token to claim ownership of a digital asset, NFT is a unique, non-exchangeable data packet that is registered in the blockchain.[5]

This is a fairly promising example to show that the usage of modalities provided by the metaverse has potential in the future development of modern dentistry.

Understanding The Metaverse

Any 3D virtual environment that enables interaction between users and non-human avatars through the use of technologies such as blockchain, augmented reality, virtual reality, and the Internet of Things can be referred to as a metaverse.[6]

Entering In Metaverse: There are numerous ways to access the metaverse, often known as cyberspace. Simple examples include installing an app on your PC. Or you may buy goggles for virtual or augmented reality.Each participant will make their own avatar once they are in the metaverse, where they can interact with others and go into conference rooms to continue their education in a 3D environment. An avatar is a moving image that portrays a person in a virtual reality setting. This setting will represent a totally new area of pedagogy[7]

Overview Of Dentistry

Dental care, including the prevention, diagnosis, and treatment of dental problems, is the emphasis of the medical specialty of dentistry. It is essential for preserving general health and wellbeing. Dentists, dental hygienists, dental assistants, orthodontists, oral surgeons, and other experts are all included in the dental sector. Challenges include limited access, high costs, and dental anxiety. The Metaverse could potentially revolutionize dentistry through tele-dentistry, training, visualization, virtual procedures, and health promotion, but data privacy and accuracy concerns must be addressed.[8]

Application Of Metavarse In Dentistry

The potential of using metaverse technology in numerous dental applications is being investigated by several studies. They provide evidence that the use of metaverse technology can enhance surgical accuracy and precision as well as effectively manage pain . For example, the technology enables virtual simulations of dental procedures, aids in the development of an efficient navigation strategy for distraction osteogenesis in patients, evaluates the efficacy of mandibular restorations, placement of implants and examines the surgical transfer of virtual orthognathic planning. use of metaverse technology in the field of dentistry, with an emphasis on oral hygiene

instruction, dental anxiety, and dental trauma, Through the use of this technology, children can effectively engage in a virtual environment that promotes the learning of oral hygiene methods while also reducing dental anxiety.[2]

There are numerous applications of the Metaverse in dentistry. Several potential uses include: Virtual Training and Education, Virtual Consultations, Virtual dental lab, Block chain technology and NFTs, Pain and Anxiety management Tele medicine and Remote dentistry[7]

Virtual Training And Education
It is expected that 2D texts and non-interactive environments would give way to 3D and interactive instruction at metaverse-powered virtual colleges, supplanting the old education system. Individuals in remote regions can study in a 3D virtual environment and interact with other students, independent of geographic, political, or health constraints. Students can gain a genuine experience of real-world learning scenarios without having to worry about location, time, or cost restrictions by interacting in 3D environments made possible by metaverse technology[9]. By giving students access to the human body through virtual reality technology, they can get a complete understanding of it and practice replicating actual DENTAL procedures. In addition, augmented reality (AR) is used to encourage hands-on educational opportunities for students, including simulating surgeon and patient interactions and assisting dental students in developing new treatment ideas and techniques.[10]

Virtual Consultations
Routine dental and medical consultations could be replaced by consultations in virtual clinics, eliminating the need to travel to hospitals and clinics and wait for hours in waiting rooms for consultations. Thus, saving both time and money.

Virtual Dental Lab
A virtual dental lab can save time and effort by collaborating remotely with the dentist and improve patient comfort .Digital scanning that comes as an addition with the virtual dental lab can improve accuracy, customizing the denal restorations and improved communication with the dental ab technician. Cutting-edge tools like 3D printing and CAD/CAM can be integrated into virtual denal lab.Although virtual dentistry labs have numerous advantages, some situations may still call for in-person evaluations, and maintaining data security is crucial in these situations. [11]

Block Chain Technology and NFT'S
The blockchain is a completely digital accounting ledger system that keeps track of transactions. spanning several computers (holographic cards or networks), which prohibits modifying previous blocks or the network consensus in the backward direction. Alternatively put, each registered block is thought of as money (such as Bitcoin), a limited resource with a digital code that is unchangeable. Using "tokens" and "NFTs" (nonfungible tokens), which are examples of smart contracts using blockchain technology to develop them. There are no transaction fees and quick payments are possible. Patients could thus use their funds to purchase both physical and virtual products and Cryptocurrency service. Using a dental membership, patients might mint NFTs which can be used later on for payments.[12]

Pain and Anxiety Management
In a review research on pain treatment, Chan et al. discovered that VR were successful at lowering pain thresholds and relieving discomfort both during and following the session[13]. In controlling procedural pain, such as during medical and dental procedures like changing a wound dressing or getting a filling, the VR treatments were highly beneficial. The research also demonstrated that VR increased patient satisfaction, reduced tension and anxiety, and improved the entire healthcare experience. The use of computer-generated visuals and sounds to create a simulated environment can be a technique to divert patients from pain sensations or to provide relaxation and mindfulness activities, according to another study by Ahmadpour et al.[14] VR have been used to provide distraction during uncomfortable medical procedures such painful injections, dental work, and burn wound care. The patient's concentration on the pain may be reduced by the immersive setting, which also gives them a sense of control and lowers their level of anxiety. VR has been found useful to deliver relaxation exercises and cognitive-behavioural therapy methods for managing chronic pain. Activities for managing pain and anxiety can be made more interesting and motivating for child patients by adding

gamification of procedure and dental prophylaxis, rewards and challenges[11].

Tele Medicine And Remote Dentistry
Tele medicine can offer a new dimension to healthcare delivery enhancing patient experience provider interaction and improving access to dental services, here's how the telemedicine could be integrated into metaverse:

Virtual Consultation And Dental Education
Patient can have virtual consultation with dentists through their metaverse avatars. They can discuss dental concerns, receive advice and even examining their oral condition using virtual representation.Dental professionals can conduct virtual workshops, seminers, and educational sessions within metaverse to educate patients and dental professionals about oral health, hygiene and procedures

Remote Monitoring
Patients with orthodontic treatment or dental implants can provide regular update through virtual visits. A dentist can monitor progress and provide guidance remotely.[15]

Teledentistry
Dentist can diagnosis and provide immediate treatment required to the individual remotely based on images and videos of the patient's oral health.

Patient Opinion
Patient can seek second opinions from specialists located elsewhere in any corner of the world getting expert advice without need to travel.

Patient Records
Dental histories, x-rays and treatment record can be securely stored within the metaverse, making easy access for both dentist and patient.

Virtual Dental Experience
Patient can explore virtual dental environment prior to dental procedure reducing anxiety and dental phobia among patients.

As with any application of telemedicine, ensuring patients privacy, data security and following ethical guidelines is important. Collaboration between dental professionals, software developers and regulatory bodies is essential to create a seamless and effective integration of telemedicine into the metaverse within the field of dentistry.[16]

Challenges
The results obtained are still not as good as those seen in real-world circumstances, despite the fact that the metaverse has given the medical industry a sizable domain to expand.

The challenges of the metaverse include Device availability and operating issue, Privacy and data security, High technology cost

Device Availability And Operating Issue
The use of VR, AR, and AI technology is crucial for the metaverse. At the moment, the metaverse cannot be widely adopted because the majority of these gadgets are neither lightweight, portable, nor inexpensive. Aside from hardware availability, it is quite challenging to find high-quality and high-performance devices that can accomplish the precise retina display and pixel density needed for a lifelike virtual world. Various companies develop different components of the metaverse, ensuring seamless interoperability among platforms could be complex and costly, potentially leading to fragmented user experiences. People needed to be trained to use all these device and have operational issues in many remote areas. A shortage of skilled professional could drive up labour cost and slow down development[17]

Privacy and Data Security
It is crucial to consider user privacy, physical safety, and psychological safety into account when developing the metaverse, especially in the healthcare industry. Metaverse keeps track of users' activity as well as their email addresses and passwords. The metaverse will undoubtedly experience serious security issues due to the sheer number of connected objects and people. It can be challenging to establish your identify in the metaverse because bots can simply duplicate your appearance, data and entire identity. For authentication, several

validation processes will be necessary, including speech recognition, facial scanning, and scanning of the retina. An individual avatar can be hacked, and private information can be leacked.[18]

High Technological Cost

The high cost of hardware, software and connectivity needed to access the metaverse could lead to digital divides. Not everyone may have the financial means to participate fully and potentially creating an exclusive digital environment. High cost might discourage startups from entering the metaverse space and if larger corporations dominate the metaverse industry due to there financial resources, it leads to monopoly.[19]

CONCLUSION

The metaverse is a large topic that is continuously being researched. Every day, fresh breakthroughs are made to improve the outcomes of metaverse modalities and has capability to expand in all the direction, After analyzing all of the benefits and cons of the metaverse, as well as the available statistics, the pros outweigh the cons. Furthermore, even the disadvantages have room for improvement and can be remedied with additional technology advancement, the implementation of user ethics, regulations, and monitoring, and the enforcement of judicial usage.[19]

Though this technology is still in its infancy, the concept of dentistry in the metaverse is an intriguing one to investigate for potential benefits to both patients and dentists.

REFERENCES

1. Review of 'Snow Crash' by Neal Stephenson. NS Ford Book Reviews; 11/12/2022
2. Locurcio, L.L. Dental education in the Metaverse. Br. Dent. J. 2022, 232, 191.
3. Nuytens, P.; D'haese, R.; Vandeweghe, S. Reliability and time efficiency of digital vs. analog bite registration technique for themanufacture of full-arch fixed implant prostheses. J. Clin. Med. 2022, 11, 2882
4. Rankohi, S., Waugh, L. Review and analysis of augmented reality literature for construction industry. Vis. in Eng. 1, 9 (2013).
5. Pham, Viet & Costa, D.B. & Liyanage, Madhusanka. (2022). Blockchain for the Metaverse: A Review.
6. Behzadan, AH, & Kamat, VR. (2008). Automated generation of operations level construction animations in outdoor augmented reality. ASCE Journal ofComputing in Civil Engineering, ASCE, 23, 405–417.
7. Kurian, N.; Cherian, J.M.; Varghese, K.G. Dentistry in the metaverse. Br. Dent. J. 2022, 232, 191.
8. Albujeer, A.; Khoshnevisan, M. Metaverse and oral health promotion. Br. Dent. J. 2022, 232, 587
9. Park, J.C.; Kwon, H.E.; Chung, C.W. Innovative digital tools for new trends in teaching and assessment methods in medical and dental education. J. Educ. Eval. Health. Prof. 2021, 18, 13.
10. Uoshima, K.; Akiba, N.; Nagasawa, M. Technical skill training and assessment in dental education. Jpn. Dent. Sci. Rev. 2021, 57, 160–163
11. Wiederhold MD, Gao K, Wiederhold BK. Clinical use of virtual reality distraction system to reduce anxiety and pain in dental procedures. Cyberpsychol Behav Soc Netw. 2014 Jun;17(6):359-65
12. Anascavage, Robert and Davis, Nathan, Blockchain Technology: A Literature Review (May 3, 2018).
13. Chan E, Foster S, Sambell R, Leong P (2018) Clinical efficacy of virtual reality for acute procedural pain management: A systematic review and meta-analysis. PLOS ONE 13(7): e0200987
14. hmadpour N, Keep M, Janssen A, Rouf AS, Marthick M. Design Strategies for Virtual Reality Interventions for Managing Pain and Anxiety in Children and Adolescents: Scoping Review. JMIR Serious Games. 2020 Jan 31;8(1)
15. Dasgupta A, Deb S. Telemedicine: a new horizon in public health in India. Indian J Community Med. 2008 Jan;33(1):3-8
16. Grigsby J, Kaehny MM, Sandberg EJ, Schlenker RE, Shaughnessy PW. Effects and effectiveness of telemedicine. Health Care Financ Rev. 1995 Fall;17(1):115-31
17. Akçayır, M., and Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: a systematic review of the literature. Educ. Res. Rev. 20, 1–11
18. Bacca, J., Baldiris, S., Fabregat, R., and Graf, S. (2014). Augmented reality trends in education: a systematic review of research and applications. J. Educ. Technol. Soc. 17, 133.
19. Iqbal MZ, Campbell AG. Metaverse as Tech for Good: Current Progress and Emerging Opportunities. Virtual Worlds. 2023; 2(4):326-342.