

ORIGINAL RESEARCH ARTICLE

Use of virtual reality in dentistry: Literature review

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ABSTRACT

Virtual reality (VR) allows its application in different fields, such as healthcare. In dentistry, this technology has enormous potential, in the educational and clinical setting. Its applications are of growing interest and importance in dentistry, especially in teaching, since it offers interactivity and high effectiveness in learning. In the treatment of dental treatment phobia, this technology is also promising, as it shows satisfactory results, and in the surgical area it has a high potential for complex treatments, allowing predictable and safe results. However, future studies should focus on establishing technological standards with high data quality and on the development of approved applications for clinical routine. Therefore, the aim of this literature review was to provide clarifications on the knowledge and scientific development of VR in dentistry.

Keywords: virtual reality; technology; education; dentistry

1. Introduction

With the technological advancement in the world, new technologies are emerging, such as virtual reality (VR), which influences several social spheres^[1] and allows its application in different fields, such as in the area of health^[2]. In dentistry, this technology allows greater safety for dental surgeons and convenience for patients in cases of dental treatment phobia^[3]. With enormous potential, this technology consists of an artificial simulation generated from a real environment or situation^[4].

It originated in the 20th century, with major advances in the 1980s^[2]. However, it has been used

in dentistry since 1998. When dental simulators were introduced at the University of Pennsylvania, School of Dental Medicine, for preclinical training in restorative dental procedures^[5].

Some of its applications consist in dental education offering interactive learning concepts with promising results, in preclinical restorative procedures^[6-8], in the areas of prosthodontics and oral surgery, as it is a promising tool for complex treatments and can provide predictable and safe results. In addition, virtual reality has been used to distract patients during clinical procedures^[9-11].

VR describes a 3D environment that the user can easily explore and interact with. Depending on

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the level of presence, virtual reality technology can be classified into immersive virtual reality that includes interactivity and user participation in the virtual environment to create a sense of “present” virtual reality and non-immersive virtual reality^[12].

It provides a subjective experience of being in a place or environment, even when physically in another place and has the characteristic of immersion, in which sensory and perceptual information can provide a therapeutic environment^[13].

It can be seen that this technology has been used in various areas of dentistry, however, there are still limited studies on the use of virtual reality. Further research is needed for the future development of this technology, so that society can use this tool properly and effectively, especially in the area of health.

Therefore, the aim of this study was to conduct a literature review on the use of VR in dentistry, so that the gaps present in the academic environment on the subject are adequately clarified.

2. Educational outreach

Technological advances in virtual reality allow its application in different areas of dentistry, mainly used for preclinical training in university settings, which positively affects the quality of learning.

Virtual reality simulators can provide a reality-like learning experience, with significant potential benefits in the teaching and self-learning of manual dental skills^[14]. In addition, it has the potential to stratify different performance levels of dental students^[15].

Gottlieb et al.^[16] in comparing the perceptions and skill expectations of dental students using virtual reality simulation to those who did not use this technology in preclinical dental training, concluded that ergonomic development and technical performance were positively affected by VR training, encouraging this technology in a preclinical dental

curriculum.

Through virtual reality, it was possible to create a caries model to determine the effectiveness of the simulator in minimally invasive caries extraction training, with improved student performance^[17].

Virtual reality improves knowledge and skill outcomes compared to traditional or other types of education, however, studies are still limited and future research should evaluate the effectiveness of this technology in addition to other variables such as attitude, satisfaction, cost-benefit and clinical or behavioral change^[18].

In some universities, this technology has already been introduced in their preclinical curriculum, with promising results as there has been an improvement in student performance, and it may be a valuable adjunct during professional training.

Virtual reality has also been used to teach anesthetic techniques using a simulator. The training of dental anesthesia to block the inferior alveolar nerve was highly appropriate considering the application of the needle in an appropriate area, depth of insertion, as well as the sensitivity of the virtual tissue resistance^[19].

This technology is becoming an essential part of modern education. The benefits of virtual reality in dentistry are constantly being evaluated as a method or adjunct to improve fine motor skills, eye-hand coordination in preclinical settings and overcome the monetary and intellectual challenges associated with student training.

When assessing the knowledge, attitudes and practice of virtual reality use among students and dental educators, found that participants have positive attitudes toward virtual reality, but very few use it in education and practice. However, most respondents plan to use this tool in the future and believe that these technologies will be widely adopted by dental practices.

As an educational tool, this technology has offered enhanced opportunities for undergraduate

students and will become a key function in the future of dental education. It offers new teaching possibilities by combining digital elements with a real learning environment. There are still several uncertainties that limit the widespread implementation of this technology. Most of these uncertainties can be resolved by continued progress in information technology.

3. Dental treatment

In addition, VR has been applied to treat patients with dental phobia, especially in children during restorative treatments, with a successful decrease in pain perception and anxiety during treatment^[20].

In pain perception during scaling and root planning procedures, VR also has the potential to become a method during clinical procedures^[21]. In distractions through virtual reality, this methodology can be considered a relevant intervention for treatments, reducing the anxiety of children undergoing procedures such as tooth extraction^[22].

In most patients, this tool was extremely or completely beneficial in reducing anxiety levels. In addition, there is a significant decrease in cortisol levels.

4. Surgical field

In surgical procedures, it was possible to evaluate the impact of virtual reality in improving surgeons' knowledge and self-confidence^[23]. This technology is promising and is applicable to any dental surgical procedure involving drilling^[24].

These technologies are not only applied in the professional field, but have also improved all fields of our life^[25]. In the dental field, implantology and orthognathic surgery are the areas with the highest frequency of VR application through virtual planning.

Bartella et al.^[26] evaluated the preoperative

usability of VR glasses to improve operative understanding in case of a deeply impacted third molar, lower jaw fracture, and oncologic resection. The authors stated that preoperative examination with VR goggles can help to better understand and plan the surgical site, being an innovative piece of advanced technology to display anatomical data.

Virtual reality is of growing interest and importance in undergraduate and postgraduate teaching in dentistry, as it offers interactive learning concepts^[27]. In oral-maxillofacial surgery, it is a promising tool for complex procedures that provide predictable and safe therapeutic outcomes. However, clinical trials with VR identified in the field of dentistry should still be considered experimental, as computerized devices and supporting software are essential for future use in clinical practice.

5. Conclusions

Virtual reality applications are of growing interest and importance in dentistry, especially in teaching, as they offer interactivity and high learning effectiveness. In the treatment of dental treatment phobia, this technology is also promising, as it shows satisfactory results, and in the surgical area it has a high potential for complex treatments, allowing predictable and safe results.

Conflict of interest

The authors declare no conflict of interest.

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