



Utilization of Virtual Reality Technology to Enhance Dental Hygiene Practices: Perspectives of Dental Hygiene Students

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Abstract

Objective: A high percentage of the general public experiences dental anxiety when visiting dental professionals for dental care and existing research indicates dental anxiety can dramatically affect patients and their oral health. It is vital for dental professionals to investigate areas for improvement and leveraging Virtual Reality (VR) technology could be an effective strategy for combating dental anxiety among patients. The objective of this research was to assess if VR would prove beneficial as a distraction method for reducing patient dental anxiety enhancing dental hygiene practices, as perceived by students in a Dental Hygiene (DH) program.

Methods: A study was conducted in a university setting consisting of students in a DH program. After obtaining internal review board approval through the authors' institution, DH students engaged in role-playing, posing as both dental hygienists and patients. Students performed the dental exam on fellow students while both sets of students completed surveys to determine if, from their perspective, the use of VR technology created a positive experience for both patients and dental hygienists during the dental exam.

Findings: Findings indicated that DH students perceived a reduction in patient anxiety when using the VR technology during dental exams. They also perceived that the VR equipment did not serve as an obstacle to dental hygienists in providing quality care to patients. Overall, DH student perceptions were favorable in relation to using VR as a distraction tool to enhance dental hygiene practices.

Conclusion: Although, additional study is needed, the use of VR technology appears to be an effective distractor for patients who experience dental anxiety and it does not create an obstacle which obstructs dental professionals from providing quality dental exams, as perceived by DH students. Therefore, this study concludes that VR is a promising tool for enhancing dental hygiene practices.



Introduction

For many years, dental anxiety has been a significant issue for people of all ages and backgrounds. Widely studied, anxiety related to dental procedures is now considered as a major obstacle for patients when seeking dental care [1,2]. One researcher found that an estimated 36% of the population is affected by dental anxiety and another 12% suffer from extreme dental fear [3]. There have also been multiple studies reviewing the epidemiology of dental anxiety and how it affects overall dental health. Specifically, it has been shown to lead to increased dental decay, missing teeth, and been proven to increase patient reluctance to undergo dental fillings [4,5].

Although there is a plethora of existing studies, the connection between dental anxiety and oral health preventive behaviors, like brushing teeth and using fluoride toothpaste, is not completely understood in this context, emphasizing the need for further study [3]. With data indicating that dental anxiety can dramatically affect patients and their oral health, it seems paramount for dental professionals to investigate areas for improvement. Leveraging technological advances, such as Virtual Reality (VR), could be an effective strategy for combating dental anxiety among patients.

Referred to as an artificial environment, VR technology uses complex technology to form synthetic stimulation to replace real-world sensory information, which means that users enter the virtual scene and use special helmets, data, gloves, or input devices such as keyboards and mice to interact with the virtual environment in real-time" [6]. This allows the user to feel as though they are in an actual environment [7]. The accessibility and applications of VR have seen continued growth in the healthcare sector in recent years. Although, in most instances VR technology has only been utilized in research settings. Furthermore, with VR trials in medicine being scarce and the broad implementation of VR platforms in clinic settings being so limited, it has not allowed the technology to really integrate into the daily working routines of healthcare professionals [8,9].

While it is understood that there is a much greater need for research in healthcare and its efficacy in the profession, studies have already taken place providing evidence that shows VR can be an effective tool for improving the treatment of anxiety disorders, psychosis, and eating disorders, among other conditions [10]. It has also been noted that VR can incorporate features like meditation, cognitive behavioral therapy, and mindfulness, which highlights how these soft concepts, which are commonly unappreciated in modern medicine can contribute to hard clinical outcomes. Furthermore, research shows that VR technology can be integrated into outpatient clinics to help advance patient education, which then leads to higher patient compliance [11].

For decades, multiple types of distraction tools have been utilized to assist in patient comfort including patient/clinician discussions, breathing techniques, headsets with calming music, movies (AV eqpt), squeeze balls, etc. The purpose of the study is to ascertain whether using VR technology will serve as a distraction tool, which can help enhance DH practices.

Materials and Methods

The design for this research was completed using a mixed methods research structure intended to evaluate findings of two surveys designed by a team of researchers, including a subject matter expert in dental hygiene, radiation oncology, and another in virtual reality. The study was fully approved by the

authors' institutional review process prior to any research being conducted.

Once the study was approved, participants were recruited through a convenience sample, consisting of Dental Hygiene (DH) students enrolled in a junior level course which they are required to complete in their undergraduate DH program. Each volunteering study participant was introduced to the study, given a consent letter indicating their participation was voluntary, and instructions that indicated they could withdraw from the study at any time without any negative consequences.

Study participants in the DH course were divided into two groups and each had two separate one-hour experiences with the VR equipment. Group one consisted of 15 DH student participants who were asked to role play as the dental hygienists. Group two consisted of 15 DH student participants who were asked to role play as mock patients. A Graduate Assistant (GA) reviewed the utilization of the VR equipment with all participants.

The mock patients watched one or more preselected videos regarding oral health education during their dental hygiene exam, which was provided by the student dental hygienist. When the dental hygiene exam was complete, group one and group two completed two separate surveys electronically through links they were provided. The following week, the groups changed roles and duplicated the above-mentioned process. DH students as study participants recorded their perceptions by completing the appropriate survey, depending on what group they were assigned. The data from both surveys were then evaluated and considered for strong associations between the responses of participants as they played their varying roles as dental hygienists and as mock patients using VR technology during a dental procedure.

Results

A total of 27 DH students were recruited for this study, and 23 agreed to participate. Some students chose not to participate once the study began. Two did not participate as a DH and three did not participate as a mock patient, after initially agreeing. All participants were female, ranging in age from 18-34 years old. When asked about the students' race and how they identified, the majority identified as White (80.95%), followed by Latin American (9.52%), with Asian and Black or African American (4.76%), as the least identified race within the study. When surveyed as a dental hygienist, DH student participants were asked, initially, how comfortable they were using VR technology? This question resulted in 14.29% being very comfortable, 61.90% considering themselves as somewhat comfortable, 19.05% somewhat uncomfortable, and 4.76% very uncomfortable with the VR technology. Study participants were also asked if learning to operate the VR equipment was easy?. This resulted in 4.76% strongly agreeing, 66.67% agreeing, 23.81% neither agreeing nor disagreeing, 4.67% disagreeing, and none strongly disagreed. Participants were also asked if they felt that providing the patient with a VR experience distracted them from providing a quality dental procedure. The reply from the participants were almost evenly divided with 9.52% saying yes, 47.62% saying no, and 42.86% provided specific reasons as to why they were distracted including:

(14.29%) - the equipment was difficult.

(4.76%) - my own VR knowledge was not sufficient to provide the VR experience effectively.

(4.76%) - the mock patient kept touching the VR unit.

(4.76%) - the mock patient was too immersed in the VR experience that they were not attentive to the student dental hygienist's requests (4.76%), and.

14.29% selected "other" - with no reason given.

The next question answered by participants playing the role as dental hygienists was, did the VR equipment prohibit completion of the DH exam? Results indicated that all participants were able to successfully complete their dental exam without the VR system impeding their work. The same participants were then asked if they would enjoy continuing to work with the VR equipment in the DH profession. There responses were:

90.47% either strongly agreed (28.57%) or agreed (61.90%).

4.76% neither agreed nor disagreed, and 4.76% disagreed.

The final question asked on the student dental hygienist survey was, did the VR equipment help distract the patient during the exam? The results indicated that:

90.48% either strongly agreed (42.86%) or agreed (47.62%) 4.76% neither agreed nor disagreed, and 4.76% strongly disagreed.

The second survey fielded to participants was the mock patient survey DH student participants who had DH exam performed on them. The initial survey question that dealt with the procedure as a mock patient asking, do dental appointments cause you apprehension? The results of the survey indicated:

25% indicated that dental exams create apprehension, for them.

75% indicated that dental exams do not create apprehension, for them.

All mock patient participants were asked if they were familiar with VR, and all indicated they were. They were then asked as mock patients how comfortable they were using VR technology. They indicated:

89.47% were either very comfortable (31.58%) or somewhat comfortable (57.89%).

(5.26%) were somewhat uncomfortable (5.26%) or very uncomfortable (5.26%),

One participant skipped the question.

DH student participants were then asked if they found learning to operate the VR equipment was easy?. The findings show that:

30% strongly agreed

65% agreed.

5% neither agreed nor disagreed.

None of the students disagreed, or strongly disagreed.

When asked if the VR equipment was comfortable to wear during the DH appointment:

25% strongly agreed,

50% agreed, and

25% neither agreed nor disagreed.

The survey then inquired into if the mock patient enjoyed the VR experience and:

100% strongly agreed,

(50%) or agreed.

(50%).

Next, mock patients were asked if they felt that the VR provided a positive distraction during the DH exam:

95% agreed that the VR provided a positive distraction.

5% did not believe that it did.

DH student participants were also asked if they felt that the VR equipment provided a negative distraction during the exam and none of the mock patients felt it had a negative effect during the procedure.

The survey then inquired if after the procedure how comfortable they were using the VR technology resulting in:

70% agreed they were either very comfortable,

30% somewhat comfortable, and

None indicated either somewhat uncomfortable or very uncomfortable.

Mock patients were then asked if the VR equipment helped them relax more during this DH exam compared to previous DH exams without the VR system and all participants either strongly agreed (55%) or agreed (45%).

The final question asked on the mock patient survey was, would you enjoy working with VR equipment during future DH dental procedures. The results were:

55% strongly agreed.

40% agreed.

5% neither agreed nor agreed, and

None of the participants disagreed or strongly disagreed.

Discussion

The purpose of this research study was to evaluate the potential overall effect of VR technology and its utilization as a distraction method for patients who experience anxiety due to dental exams using role play with DH students acting as either dental hygienists or mock patients. Within this study the researchers also evaluated the perception of the DH students, who were role playing as dental hygienists and how it affected their ability to perform dental procedures on patient procedures. When reviewing the study results, it becomes obvious that VR technology shows promise in being a beneficial distraction tool for patients with anxiety during dental procedures, from the perspective of DH students. The results from this study show many of the DH students when, playing the patient role believed the VR technology provided a positive distraction during the dental exam, which in turn could lessen patient anxiety. It also correlates to the question asked regarding their perception of DH exams both with and without the VR technology and were they more relaxed with the VR technology? All the DH students indicated a positive correlation to the technology and felt more relaxed when the technology was utilized, when playing the patient role. This was supported in the literature review that revealed one study indicated the positive correlation

with VR technology was linked to the fun factor for individuals. Specifically, gamification of content where it increases fun and possibly brings about new incentives when used [8].

Other previous research has indicated similar results when VR technology is being used for patients. One specific study looked at burn patients and evaluated their perception of their pain and how these patients believed the VR system effectively reduced their pain compared to those who were only taking part in the standard physical therapy [11] and this was also found to be true for children experiencing pain due to cancer [12]. More specifically within the dental profession, VR technology has been utilized to help reduce patient pain during the removal of plaque at the gumline, and patients described a considerable reduction of pain with the use of VR technology when compared to other patients who did not have any distraction or even compared to patients who were watching a movie as a distraction [13]. These studies seem to correlate to what this study found when you consider the responses of the mock patients and that 100% of the mock patients found the VR technology to positively influence their ability to relax during the procedure compared previous exams and not having any distractions available.

Another important attribute of this study is the overall experience of the DH students when working with the VR equipment. Each question that addressed their comfort level with the technology when operating the equipment showed to be positive overall. The study also indicated that the DH students had some previous experience with VR technology, which could have skewed the findings of the study in a positive direction considering they were all around college age and have most likely had greater exposure to this technology compared to older patients. It would be interesting to see if these results would have been paralleled in an older age group where one may have less experience with this type of technology another area of concern when utilizing this equipment is in pediatric and geriatric patients during dental procedures given issues associated with visual fatigue from repeated exposure. [14-16]. Additionally, a perceived limitation to consider is that since all participants were DH students, their knowledge and comfort with dental procedures may have provided a skewed representation of a real patient with dental anxiety.

Conclusion

For the public, the field of dentistry is a profession that causes anxiety and fear when thinking about dental procedures and exams. Looking for technological advancements to alleviate these overall negative perceptions and feelings, largely falls to those in dental professions. Although, VR has been studied in different fields of dentistry, there is limited research regarding the use of the technology as a distraction tool as a reduction of patient anxiety, especially from the hygienist's perspective. Further study on this topic is also needed to help better evaluate how VR technology can improve quality.

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