

Evolving Role of Virtual Reality In Overcoming Weaknesses of Traditional Treatment Methods In Treating Dental Anxiety Among Patients

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ABSTRACT:- Dental Anxiety is one of the common reasons for people not visiting dentists. Although technological advancements in dentistry provide dental treatments in a less traumatic way, some people still have the fear of seeing dentists to get their dental treatments done and they end up getting more dental complications which compromise their general health which in turn reduces their quality of life. So, it is vital to treat dental anxiety and there are several treatment methods available to treat the same which come under two major categories; pharmacological and psychotherapeutic approaches. These approaches have their own merits and disadvantages. Albeit VR has many applications like VR simulators to teach dental students, this paper focuses on its emerging role in treating dental anxiety as the benefits of using VR method outweigh the disadvantages associated with the traditional methods. Based on the evidences discussed, VR has the prospect of playing an important role in solving the issue of dental anxiety among patients.

I. DENTAL ANXIETY

According to the American Psychological Association (APA) anxiety is defined as an emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure (APA, 2017). In some difficult life threatening situations, it helps for survival as it elicits fight or flight reaction through adrenalin rush to protect from dangers. Dental Anxiety can be referred to as unwanted fear or anxiety towards visiting dentist and getting dental treatments both preventive and maintenance care. It has been cited as the fifth-most common cause of anxiety by Agras et al (Appukuttan, 2015). Between 9% and 20% of Americans avoid going to the dentist because of anxiety or fear (WebMD, n.d.) and in general, approximately 1 in 6 adults experiencing severe forms of dental anxiety and fear (Raghad Hmud, 2008). It is becoming the universal phenomena. Dental phobia is another common and serious condition than Anxiety. People with dental phobia show persistent, unrealistic, and intense fear of a specific stimulus in the dental office environment (Appukuttan, 2015). These people are aware that these fears are irrational but they are unable to do anything to overcome as it is overwhelming. As a result, they tend to exhibit avoidance behaviors such as not visiting dentist and visiting only when they experience severe dental pain.

II. CAUSES OF DENTAL ANXIETY

The cause for dental anxiety is multifactorial and no single factor contributes to its development. Some of them include: personality characteristics example could be neuroticism, embarrassment & loss of personal space due to dentists working closely with patient, feeling of helplessness & not able to control the situation by not knowing what is being done in the mouth, fear of anesthetic side effects such as dizziness & nausea, fear of pain which is the very common cause, due to past traumatic dental experiences, hearing unpleasant stories from family members' dental visits or their peers via vicarious learning, fear of needles, fear of drilling sound in cavity preparations, fear owing to hearing the sound of moaning patients, fear of mercury poisoning, fear of exposing themselves to radiation, blood-injury fears and fear of choking/gagging. All these act as potential triggers to increase/aggravate people's anxiety towards dentist/dental treatments which put their oral health at stake which in turn affects their quality of life.

III. CONSEQUENCES OF DENTAL ANXIETY

Due to the avoidance behavior, anxious /fearful individuals always try not to seek dental treatments. Even if they visit dental offices, they skip follow up appointments. A Canadian survey showed that 49.2% in a high fear group had ever avoided a dental appointment as opposed to only 5.2% had avoided from the no or low fear group (Dailey YM, 2001). Because of the infrequent dental visits, these anxious individuals become more prone for missing teeth, decayed tooth, periodontal problems and infections in the oral cavity (Appukuttan, 2015). In some instances, especially when these individuals are immunocompromised these oral infections

might spread to other internal organs pushing them to seek general medical services for taking antibiotics and other treatments. Further, when these anxious individuals only visit dentists for their extreme pain, they end up getting some complicated dental treatments which aggravate their existing fear associated with dentists. In addition, handling such anxious patients is very stressful and challenging compared to non-fearful patients for dentists (Brahm CO, 2012). One of the reasons could be limited co-operation they get from the fearful patients that requires longer treatment time and the reduced satisfaction from anxious patients as they have higher expectation on their appearance of teeth (Raghad Hmud, 2008).

Conventional Treatment Options for Dental Anxiety

It is inevitable to address dental anxiety and various treatment modalities are available to address the same. The treatment modalities can be categorized into psychotherapeutic and pharmacological methods. Under psychotherapeutic methods there are many options namely relaxation technique such as breathing and muscle relaxation (DA - Dentist will need to be trained on this relaxation technique); guided imagery which helps patients to develop a mental image of tranquil pleasant experience (DA - dentist should be trained with a script to take patient to the imaginary situation if patients are not able to imagine on their own); biofeedback that assists patients to gain self-regulation of the physiological process being monitored (DA - implementing this technology requires special instruments and training of dentist); hypnotic therapy works on the principle of guided imagery, distraction and relaxation techniques (DA - cannot be used on patients with mental illness, requires training for dentist and the effectiveness depends on individuals susceptibility to hypnosis); distraction such as music diverts patient's attention from focusing on what could be perceived as a painful procedure; enhancing control through tell-show-do and modelling techniques lets patients feel that they are in control of the treatment procedure; systematic desensitization or exposure therapy involving encouraging patients to discuss their anxiety, teaching relaxation technique and exposing them to situations from least to most anxious (DA - this technique requires more caution due to adverse effects and limited evidence – (Ava Elizabeth Carter, 2014)); positive reinforcement involves rewarding desired behavior through positive voice modulation, facial expression, verbal praise and expression of physical affection (DA - should be individualized, practiced frequently and results vary over time - (Roberts JF, 2010)); cognitive therapy is one of the most effective and accepted treatment for anxiety that helps patient to change and reformat the content of negative thoughts and feelings which trigger anxiety (DA - like other methods this also requires dentist special training – (Wide Boman U, 2013)(Berggren U, 2000)(Appukuttan, 2015)).

Pharmacological methods include sedatives to depress central nervous system (CNS) based on the degree of CNS depression it could be classified into conscious, deep and general anesthesia. In conscious sedation verbal contact of the patient is maintained throughout the procedure and it could be administered through inhalation, intravenous, oral, sublingual, intranasal, intramuscular or rectal. Deep sedation is used for treating patients with moderate anxiety in which patients cannot be aroused but they will respond to severe painful stimuli. Some patients may need ventilator support but cardiovascular function is not impaired. General anesthesia on the other hand requires frequent ventilator support and patient won't respond to even painful stimuli and cardiovascular may also be impaired.

IV. VIRTUAL REALITY IN DENTISTRY

Virtual reality (VR) technology combines multiple human-computer interfaces in order to simulate various sensations such as visual, haptic, auditory etc which give the user a sense of presence in a virtual world immersing the users in a computer-generated scene and interact using natural human motions (Dr. Abhishek Seth, 2010). In other words, the term VR is used to describe a three-dimensional, computer generated environment which can be explored and interacted with by a person (VR Society, 2017). VR has a wide range of applications to include medicine, entertainment, engineering and design, military, education, prototyping and architecture (Paolis, 2003).

VR has a long history beginning in 1962 when the first US patent was filed by Morton Heilig known as Sensorama simulator. Then in 1966, Thomas Furness also known as the grandfather of VR created the first ever application for use in display systems for pilots (US Patent No. US3050870A, 1961). In 1989, the modern-day term of Virtual Reality was created by Jaron Lanier (Paolis, 2003). The VR industry grossed \$50M in 1993 (Paolis, 2003) growing to \$14.1 billion (Statista, 2018) thanks to ever growing application of VR in entertainment industry to computer technology applications to medicine.

While the VR technology has been used in medicine field for training students through simulations for a long time, its application in other areas such as pain control and therapy is still in the very early stages of implementation. In the past, VR techniques have proven to engage and relax adults through use of colored glasses to experience a three-dimensional computer-generated image during dental treatment (Sullivan C S. P., 2000). The use VR technology has been evolving slowly and it has come to a stage where Dentists are using it in real clinical applications. As described above, cognitive behavior therapy (CBT) is one of the basic

techniques used to alleviate dental anxiety; VR however, combines CBT and in-vivo exposure therapy which allows patients to work through their fears in a realistic environment without leaving the dental office (NSAC, 2017). As shown in Figure 1 and Figure 2, in a dental office, a VR headset programmed to take patients to a pleasant environment that they enjoy helps them harness the power of the mind to manage anxiety.

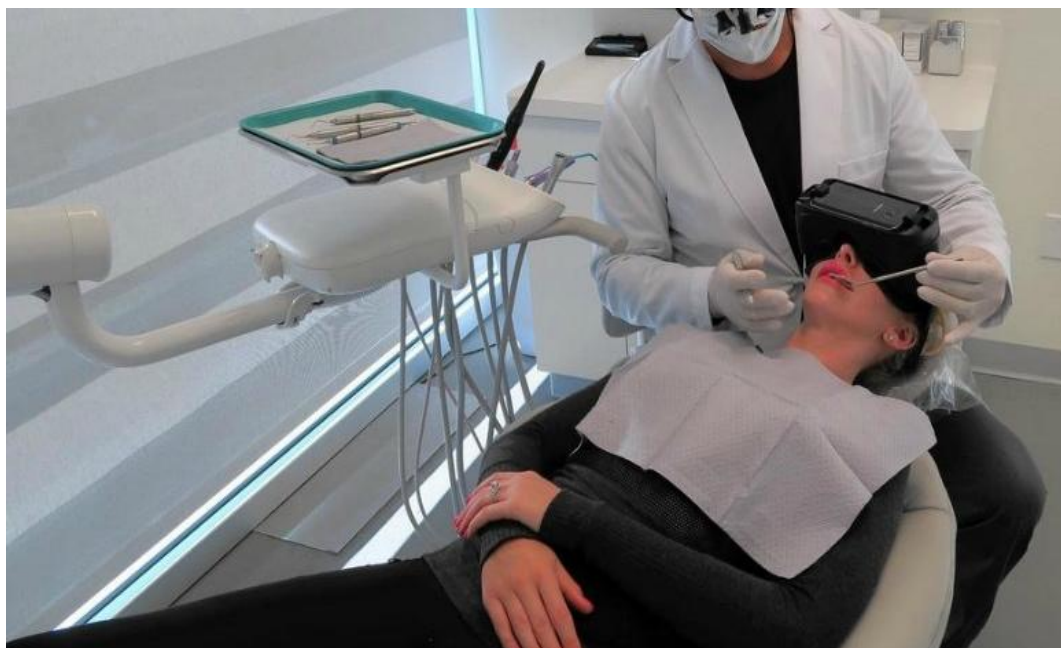


Figure 1: A Dental patient wearing a Virtual Reality (VR) headset during dental procedure (Sobic, 2017).
Sobic, A. (2017, Jul 12). *Off the cusp*. (P. Dental, Producer) Retrieved from 8 Intriguing Application for Virtual Reality in Dental: <https://www.offthecusp.com/wp-content/uploads/2017/07/dental-patient-wearing-virtual-reality-goggles-during-visit.jpg>



Figure 2: A patient wearing a VR headset to immerse into a different environment to distract from an anxious treatment (Papadopoulos, 2018).

Papadopoulos, L. (2018, Jun 13). *Interesting Engineering*. Retrieved from French Hospital Tests VR Technology as a Replacement for Anesthesia: <https://interestingengineering.com/french-hospital-tests-vr-technology-as-a-replacement-for-anesthesia>

Evidence of effectiveness of VR in dentistry

The evidence of clinical trials of VR in dentistry is still emerging but the studies conducted thus far show clear evidence of its effectiveness in dentistry. In a case study involving two patients receiving VRET (Virtual Reality Exposure Therapy) for a 20 and 25 minutes' appointment, VRET not only resulted in a downward trend for anxiety score but the gains were maintained until 6-month follow up visits (Kumar Raghav, 2017). Hunter et al explored whether immersive VR could be an effective non-pharmacological analgesic for dental pain concluded VR as a potential viable adjunctive non-pharmacologic analgesia for dental pain (Hunter G. Hoffman, 2004). In a randomized clinical trial of 120 children aged 4-6 years old, there was a significant decrease in pain perception and state anxiety score using VR glasses during dental treatment (Naser Asl Aminabadi, 2012). Investigating the effect of VR on 26 children ages 5-7 years old on anxiety and behavior, the study concluded that there was no significant effect on the behavior or anxiety but it significantly reduced the pulse (Sullivan C S. P., 2001).

Advantages of using VR/VRET in a dental practice over conventional treatment methods

- VRET is flexible to use which means the exposure scenarios can be repeated or paused according to patients' needs and desires (Kumar Raghav, 2017) and it is a non-invasive approach to treat dental anxiety.
- It does not require any special training for dentists as it can be administered by dental assistant or anyone who just have the basic computer and VRET software knowledge to operate it (Kumar Raghav, 2017).
- As in conventional relaxation treatments, patients do not need to practice anything or attend any instructional session.
- It could be a better alternative to people who are not able to tolerate the side effects of drugs used in the conventional treatment of anxiety.

V. CONCLUSION

Although many studies have shown that when people get older, they would become less anxious but dental anxiety is common among adults with a high prevalence rate. So, it is imperative to use innovative approaches to make those anxious patients calm during dental treatments. One of the innovative approaches evolving today is virtual reality. When compared to conventional treatment methods, virtual reality has a potential to treat dental anxiety more effectively. This is evident from the efficacy of prior clinical trials done on anxious dental patients of both adults and children. This technology shows promising future but it would require more clinical trials on a wider scale to evaluate its effectiveness in treating dental anxiety for its mass adoption.

REFERENCES

- [1]. APA. (2017). *Psychology Topics*. Retrieved from Anxiety: <http://www.apa.org/topics/anxiety/>
- [2]. Appukuttan, D. P. (2015, Nov). Strategies to manage patients with dental anxiety and dental phobia: literature review. *Journal of Clinical, Cosmetic and Investigational Dentistry*, 8, 35-50.
- [3]. Ava Elizabeth Carter, G. C. (2014, Nov 16). Pathways of fear and anxiety in dentistry: A review. *World Journal of Clinical Cases*, 2(11), 642-653.
- [4]. Berggren U, H. M. (2000, Sep). Relaxation vs. cognitively oriented therapies for dental fear. *Journal of Dental Research*, 79(9).
- [5]. Brahm CO, L. J. (2012). Dentists' views on fearful patients. Problems and promises. *Swedish Dental Journal*, 36(2), 79-89.
- [6]. Dailey YM, H. G. (2001, April). The use of dental anxiety questionnaires: a survey of a group of UK dental practitioners. *British Dental Journal*, 190(8).
- [7]. Dr. Abhishek Seth, D. J. (2010, Jan). Virtual Reality for Assembly Methods Prototyping - A Review. *Iowa State University Digital Repository*.
- [8]. Heilig, M. L. (1961, Jan 10). *US Patent No. US3050870A*.
- [9]. Hunter G. Hoffman, A. G.-P. (2004, Jul 5). The Effectiveness of Virtual Reality for Dental Pain Control: A Case Study. *Cyber Psychology and Behavior*, 4(4).
- [10]. Kumar Raghav, G. R. (2017). Virtual Reality Exposure Therapy for Treatment of Dental Phobia. *General Dental Practice*, 44, 423-435.
- [11]. Naser Asl Aminabadi, L. E. (2012). The Impact of Virtual Reality Distraction on Pain and Anxiety during Dental Treatment in 4-6 Year-Old Children: a Randomized Controlled Clinical Trial. *Journal of Dental Research, Dental Clinic, Dental Prospects*, 6(4), 117-124.
- [12]. NSAC. (2017, Dec). *Cognitive Behavioral Therapy*. Retrieved from Using Virtual Reality Therapy for Phobias: <http://centerforanxietydisorders.com/virtual-reality-therapy-for-phobias/>
- [13]. Paolis, L. T. (2003). *Augmented and Virtual Reality Lab*. Retrieved from Virtual and Augmented Reality Applications: <http://avrllab.it/wp-content/uploads/2015/03/lez-1-introduction.pdf>

- [14]. Papadopoulos, L. (2018, Jun 13). *Interesting Engineering*. Retrieved from French Hospital Tests VR Technology as a Replacement for Anesthesia: <https://interestingengineering.com/french-hospital-tests-vr-technology-as-a-replacement-for-anesthesia>
- [15]. Raghad Hmud, L. J. (2008, Nov). Dental Anxiety: Causes, Complications and Management Approaches. *International Dentistry*, 9(5).
- [16]. Roberts JF, C. M. (2010, Aug). Review: behaviour management techniques in paediatric dentistry. *Eur Arch Paediatr Dent*, 11(4).
- [17]. Sobic, A. (2017, Jul 12). *Off the cusp*. (P. Dental, Producer) Retrieved from 8 Intriguing Application for Virtual Reality in Dental: <https://www.offthecusp.com/wp-content/uploads/2017/07/dental-patient-wearing-virtual-reality-goggles-during-visit.jpg>
- [18]. Statista. (2018). *Projected size of the augmented and virtual reality market 2016-2022*. Retrieved from Forecast augmented (AR) and virtual reality (VR) market size worldwide from 2016 to 2022 (in billion U.S. dollars): <https://www.statista.com/statistics/591181/global-augmented-virtual-reality-market-size/>
- [19]. Sullivan C, S. P. (2000, Jun). The effect of virtual reality during dental treatment on child anxiety and behavior. *Journal of Dentistry for Children*, 193(6).
- [20]. Sullivan C, S. P. (2001, May 1). The effect of virtual reality during dental treatment on child anxiety and behavior. *ASDC Journal of Dentistry for Children*, 67(3), 160-1.
- [21]. VR Society. (2017). Retrieved from What is Virtual Reality?: <https://www.vrs.org.uk/virtual-reality/what-is-virtual-reality.html>
- [22]. WebMD. (n.d.). *Oral Care References*. Retrieved from Easing Dental Fear in Adults: <https://www.webmd.com/oral-health/easing-dental-fear-adults#1>
- [23]. Wide Boman U, C. V. (2013, Jun). Psychological treatment of dental anxiety among adults: a systematic review. *European Journal of Oral Science*, 121(3).

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