



World News of Natural Sciences

An International Scientific Journal

WNOFNS 23 (2019) 24-33

EISSN 2543-5426

Virtual Reality: A Breakthrough in Pain Management?

Adesola O. Abiodun^{1,*}, Miracle A. Adesina^{1,2}

¹Department of Physiotherapy, University of Ibadan, Ibadan, Nigeria

²Cephas Health Research Initiative Inc, Ibadan, Nigeria

*E-mail address: aoabiodun02@gmail.com

ABSTRACT

Virtual reality is a computer-generated scenario in which the user can interact in 3 dimensions so that the user feels that he or she is part of the scene. Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. Pain is often undertreated and this comes along with several consequences such as anger, depression, anxiety, workplace absenteeism, underemployment, unemployment and fear, among others. In the past decade, there has been need to find a safer way of controlling chronic pain without the necessary complication of opioid misuse. Virtual reality has been proved to be a safer adjunct for this. Several studies have reported that virtual reality is quite effective for pain management, with participants reporting significant relief of symptoms. The discovery of the use of virtual reality in the management of pain may prove to be a breakthrough in pain medicine, saving people from the complications of prolonged opioid use and opioid misuse. However, more research still has to be done to fully establish the mechanism of action and use of virtual reality in pain management, especially in the management of chronic pain. This would be a true breakthrough, allowing the full safety and effectiveness of virtual reality to be harnessed.

Keywords: Pain, virtual reality, breakthrough

1. INTRODUCTION

Sherman and Craig (2002) defined virtual reality as a computer-generated scenario in which the user can interact in 3 dimensions so that the user feels that he or she is part of the scene. The virtual reality system consists of the external tools (senses); internal tools (trackers,

gloves, joysticks e.t.c.); a system of graphic imaging rendering that creates the virtual environment; and the software and database. These work together, making the virtual reality system facilitate the interaction between the senses (olfactory, auditory, visual or haptic) and a virtual reality, to enable the person experience the virtual reality as if it were real (Riva, 2006; Matijevic et al, 2013). The characteristics of the components of virtual reality used may greatly influence the response of the users, necessitating appropriate choices of the component before use (Rand et al, 2005; Dahlquist et al, 2007; Mahrer and Gold, 2009; Gupta et al, 2017).

The International Association for the Study of Pain defined pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (Merskey et al, 1979). Pain is a personal experience, it is a subjective phenomenon. McCaffrey and Beebe (1989) explained that “pain is whatever the person experiencing it says it is.” Hence, pain management should be beyond management of the underlying tissue injury, since the experience may be emotional. Plato described pain as a penalty arising from within the body, which may be more of an emotional experience (Kumar and Elavarasi, 2016).

Pain, being a broad concept, can be classified based on different criteria. The classification can be based on duration, location, intensity, type of patient, the circumstances of the pathology, e.t.c. (Thienhaus and Cole, 2002). Based on the duration of pain, pain can be largely classified into acute and chronic pain (Turk and Okifuji, 2001; Mcpherson et al, 2004). Acute pain is defined as pain of less than three (3) to six (6) months; and chronic pain is pain that persists beyond 6months, or after tissue healing is complete. However, acute and chronic pain are no longer defined based on their duration alone anymore, as it has been discovered that beyond the duration, the two types of pain differ in underlying pathologies and characteristics (Jacox et al, 1992; Carr and Goudas, 1999; Chapman and Nakamura, 1999; Dunajcik, 1999; Jacobsen and Mariano, 2001).

As much as pain is a common concept, it is often undertreated (Carr and Goudas, 1999). Several consequences have been related to untreated and undertreated pain. These include anger, depression, anxiety, workplace absenteeism, underemployment, unemployment, fear, among others (Teoh and Stjernsward, 1992). However, over the years, pain management has received focus with the development of different methods of managing pain, and safety as a major consideration (Becker et al, 1997; Butler et al, 1997; Fox et al, 2000). One of such forms of management is virtual reality.

The concept of virtual reality has existed for several decades, but has received more attention than ever in recent times. This development has been largely attributed to technological advancements and substantial investment in the industry (Van Bottenburg and Salome, 2010). This intervention has been found to be useful for pain management (Kuhlen and Dohle, 1995; Rose et al, 1996; Jack et al, 2001; Reid, 2002; Tarr and Warren, 2002; Fulk, 2005; Haik et al, 2006; Mirelman et al, 2010; Albiol-Perez et al, 2015). Virtual reality has been reported to have enhanced safer practicing and training environment, and also ensured customization of treatment needs with increased flexibility of assessment and training procedures (Sveistrup, 2004; Rizzo and Kim, 2005).

In the past decade, there has been need to find a safer way of controlling chronic pain without the necessary complication of opioid misuse, and virtual reality has been proved to be a safer adjunct for this (Gershon et al, 2004; Chan et al, 2007; Hoffman et al, 2008; Maani et al, 2011; Mosso et al, 2012; Jones et al, 2016).

2. PRINCIPLE OF MANAGEMENT OF PAIN USING VIRTUAL REALITY

As a modality that has been discovered to have therapeutic value in the management of pain, it is important to understand, the principle by which this therapeutic value is achieved. The principles by which virtual reality helps in managing acute and chronic pain vary. The process of acute pain management has been largely related to the distraction of the individual from the pain (Distraction Therapy). This is because pain requires attention and people have limited capacity for paying attention (Villemure and Bushnell, 2002). Hence, an individual who is experiencing pain and is immersed in the “pleasurable” world of virtual reality, has limited attention left to process the pain signals in the body (Melzack and Wall, 1965; Malloy and Milling, 2010; Hoffman et al, 2011). Dahlquist et al (2007) suggested that in distracting an individual from his or her pain, interactive distraction such as virtual reality is more effective than passive distraction.

In the management of chronic pain however, there are more opinions suggesting that the use virtual reality in combination with cognitive behavioural therapy (CBT) is the effective principle of pain control (Shiri et al, 2013; Loreto-Quijada et al, 2014; Morris et al, 2015; Garcia-Palacios et al, 2015). The pain pathways involving attention, emotion, concentration, memory, touch, auditory and visual senses are altered directly or indirectly through this concept (Gold et al, 2007; Mahrer and Gold, 2009; Garrett et al, 2017). The subjective perception of pain by the individual is changed by altering the sensory, cognitive and affective traits of pain (Mura, 2010). The overall reduction in activities in the pain matrix may lead to consequent increase in the activity in the anterior cingulate cortex and orbitofrontal regions of the brain (Li et al, 2012). Hoffman (2004) opined that virtual reality may change the physical registration of pain by the pain and not just the perception of the stimuli. The exact neurophysiologic mechanisms involved in chronic pain modulation are unknown. It is suggested that the descending inhibitory pathways in the CNS are involved in this process (Sharar et al, 2008). However, there is more evidence suggesting that virtual reality works based on the principle of distraction than on direct or indirect alteration of the sensory, cognitive and affective traits (Bantick et al, 2002; Malloy and Milling, 2010; Gupta et al, 2017) and more research has to be carried out to explore this area.

3. EFFICACY OF VIRTUAL REALITY IN PAIN MANAGEMENT

Over the years, several works have been done to ensure safe and effective management of pain, especially with the rise in incidence of opioid abuse around the world. Following the attention virtual reality began to receive, it has been considered important for its efficacy to be investigated. Several studies have reported that virtual reality is quite effective for pain management, with participants reporting significant relief of symptoms (Cole et al, 2009; Saring-Bahat et al, 2010; Patterson et al, 2010; Botella et al, 2013; De Tommaso et al, 2013; Ramachandran and Seckel, 2013; Wiederhold et al, 2014). It has been found to be quite effective in women, men and children alike. There are evidences supporting the use of virtual reality therapy in the management of fibromyalgia, pruritus, phantom limb pain, pain from physical trauma, chronic headache, migraine, pains from burns, among others (Hoffman et al, 2001; Cole et al, 2009; Leibovici et al, 2009; Patterson et al, 2010; Botella et al, 2013; Ramachandran and Seckel, 2013; Shiri et al, 2013; De Tommaso et al, 2013). Studies have

shown that virtual reality can be used as a safe adjunct or alternative to the use of opioids (Hoffman et al, 2000; Hoffman et al, 2001; Gershon et al, 2004; Patterson et al, 2006; Chan et al, 2007; Sharar et al, 2007; Van Twillert et al, 2007; Hoffman et al, 2008; Maani et al, 2008; Maani et al, 2011; Mosso et al, 2012).

There is significant research supporting the use of virtual reality in the management of acute pain, however, this cannot be said about chronic pain, necessitating need for research in this area (Li et al, 2012; Keefe et al, 2012). Only few studies have examined the efficacy of virtual reality in the management of chronic pain. It has recently been discovered that virtual reality can be used to augment hypnosis in the treatment of chronic pain (Oneal et al, 2008). However, it is currently unknown whether virtual reality has an effect on chronic pain or not, even though some studies have reported relief of pain symptom in participants (Jones et al, 2016).

4. BREAKTHROUGH OR NOT?

Over the years, opioids have been largely used in the management of pain. However, in recent years, cases of opioids misuse, addiction and dependence have increased and become alarming, resulting in the death of millions of individuals around the world (Vowles et al, 2015; Hser et al, 2015; Rudd et al, 2016). Several studies have revealed that virtual reality is quite efficacious in the management of pain, and can be used as an adjunct or alternative in pain management (Hoffman et al, 2000; Hoffman et al, 2001; Gershon et al, 2004; Patterson et al, 2006; Sharar et al, 2007; Van Twillert et al, 2007; Chan et al, 2007; Maani et al, 2008; Hoffman et al, 2008; Mosso et al, 2012; Jones et al, 2016). This situation has stimulated pain physicians to look for other methods of pain control that are effective, but safer than the use of opioids (Jones et al, 2016). Hoffman et al (2007) also reported that the analgesic effect produced by virtual reality is similar to the magnitude of pain relief produced by clinically relevant doses of systemic opioids.

The discovery of the use of virtual reality in the management of pain may prove to be a breakthrough in pain medicine, saving people from the complications of prolonged opioid use and opioid misuse. However, a lot of research still has to be done to fully establish the mechanism of action and use of virtual reality in pain management, especially in the management of chronic pain. This would be a true breakthrough, allowing the full safety and effectiveness of virtual reality to be harnessed.

5. CONCLUSION

In conclusion, virtual reality has been suggested as an effective and safer approach to the management of pain. It can be used in place of opioids, thereby helping the fight against opioid abuse. However, due to the differences in the characteristics of acute and chronic pain, the approach does not follow the same principle in the management of the two types of pain. While there are several studies supporting the use of virtual reality in the management of acute pain, there are limited studies to support the use in the management of chronic pain. More research has to be carried out to investigate the effectiveness of virtual reality in the management of chronic pain. This may prove to facilitate better pain management.

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