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## REVIEW ARTICLE

# DISTRACTION USING VIRTUAL REALITY TECHNOLOGY: A REVIEW

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## Abstract

People who are highly anxious about undergoing dental treatment are reported to be one in seven of the population. Such kinds of patients require careful and considerate management by dental practitioners. Dental practitioners have numerous methods to control anxiety and pain in children, adults and distracting them appears to be the most common technique used for behavior management during dental procedures. This review focuses on the application of technologically advanced method of virtual reality (VR), which enables individuals to immerse themselves in a virtual world. Thus VR creates a nonpharmacological form of analgesia by changing the activity of the body's intricate pain modulation system and reducing dental anxiety in the dental office. **CONCLUSION:** VR is a viable technique and is effective in majority of patients; still much research needs to be done to obtain a clearer picture.

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## INTRODUCTION

The young child's emotional and behavioral response to dental treatment is a primary objective of the paediatric dentist and researchers. Young children commonly respond to the stress of dental visits with some fear and anxiety (Venham et al 1981). The impact that this relatively high level of dental fear in the community can have is appreciable. Firstly, people with high dental fear are much more likely to delay or avoid dental visiting, and a number of fearful people regularly cancel or fail to show for appointments. Secondly, children and adults with high dental fear, may prove difficult to treat, require more time, and present with behavioral problems which can result in a stressful and unpleasant experience for the both, the patient as well as treating dental practitioner (Armfield et al 2013). In order to reduce fear and anxiety, effective technique options have been facilitated in the dental setting thus shifting a child's focus to engrossing and fascinating distracters. These Distracters can be either in active or passive form, and active forms promote a child's participation involving several sensory components such as interactive toys, controlled breathing, guide imagery and relaxation (Nuvvula et al 2015). Conversely, passive forms achieve distraction through a child's observation of an activity or stimulus rather than their explicit partaking for example listening to music, watching TV (Atiken et al 2002). Two forms of passive distraction, widely used and studied in dentistry are audio (various categories of music) and audiovisual distraction (TV and two-dimensional video glasses). The application of distraction is based on the assumption that pain perception has a large psychological component in that the amount of attention directed to the noxious stimuli modulates the perceived pain (Andreas et al 2005). In the recent years, there has been an increase in behavioral research in virtual reality (VR) and virtual world. VR distraction is a unique in that it is immersive and engaging, integrating many sensory experiences, and thus capturing a greater degree of attention.

## CONCEPTUAL MODELS OF ATTENTION AND PAIN:

Distraction is a pain management technique that has been shown to successfully reduce pain and behavioral distress in children undergoing invasive medical procedures. Distraction techniques tax the patient's limited attention capacity, resulting in the withdrawal of attention away from the noxious stimulus. Although the precise mechanism of distraction is not yet well understood, Cognitive-affective attention models, Multiple resource model of attention, Capacity model of attention, and Gate control theory can help in enhancing the effects of distraction (Andreas et al 2005, Nicole et al 2009)

### Cognitive-affective attention models:

Mc Caul and Malott (1984) proposed two major principles behind the potential for distraction to reduce pain: (a) Pain perception requires controlled processing such that one must actively attend to the painful stimulus in order to cause distress and (b) attention capacity is limited. Thus, the degree to which a distraction task effectively interferes with pain processing will be determined by the amount of attention resources it captures (Emily et al 2011)

### Multiple resource model of attention:

According to multiple resource model of attention proposed by Wickens(1984,2007),there are relatively independent resources for the processing of sensory information, such that two tasks demanding the same sensory modality will result in a greater decrement in performance on one or both tasks compared to two tasks demanding different levels of that dimension(e.g one visual perception task and one auditory perception task).Thus distraction tasks that utilize the same sensory attentional resources as the pain stimulus should interrupt pain perception most effectively ( Emily et al 2011)

### Capacity model of attention:

Ecceleston and Crombez (1999),proposed that to be optimally effectively,distraction should also take into account the effective nature of the pain experience.Tasks that elicit strong positive effect may compete with pain more effectively than neural tasks. (Emily et al 2011)

### Gate control theory:

Melzack and Wall proposed the Gate Control Theory, which states that CNS activities (e.g. attention, emotion, memory) play a role in sensory perception.When pain signals travels through the body, they must pass through the "nerve gate" before the body can determine the level of awareness.In other words, the level of attention paid to the pain, the emotion associated with pain and past experience with pain, all play a role in how that pain is individually interpreted.

Therefore, the ideal distracter would require an optimal amount of attention involving multiple sensory modalities (visual, auditory and kinesthetic), active emotional involvement and participation of the patient to compete with the signals from the noxious stimulus.

Recently, GOLD et al hypothesized that VR analgesia originates from intercortical modulation among signaling pathways of the pain matrix through attention, emotion, memory and other senses (e.g touch, auditory and visual), thereby producing analgesia.An overall decrease of activities in the pain matrix may be accompanied by increases of activity in the cingulate cortex and orbito-frontal regions of the brain (Gold et al 2011).

## VIRTUAL REALITY:

A range of fear management techniques have been described in order to reduce fear or anxiety in child and thus facilitate coping in the dental office.They can be grouped into five general approaches physical restraint,pharmacological methods,behavior modeling,reinforcement/contingency techniques and distraction

methods. Clinical and research reports provide varying degrees of support for the effectiveness of each method. There is evidence that focusing attention on specific visual or auditory stimuli in the dental clinic might be beneficial for patients with mild to moderate dental anxiety. While several options are available for the clinician, ranging from background music to television sets to computer games to 2D or 3D video glasses for watching movies (Armfield et al 2013). These techniques are referred to as virtual reality (VR), audiovisual systems, A/V eyeglass systems, or simply A/V distraction (Andreas et al 2005). However, these A/V distraction techniques do not allow any interaction between the users and the stimuli they are exposed to, and no use is made of kinesthetic stimuli. The most recent and most advanced distraction technique is VR, which makes up for this lack of interaction and kinesthetic stimulation.

VR distraction is unique in that it is immersive and engaging, integrating many sensory experiences, and thus capturing greater degree of attention (Nicole et al 2005) becomes possible through the use of interactive virtual environments (VE). VR refers to a human computer interface that enables the user to interact dynamically with the computer-generated environment. VR uses sophisticated systems such as head-mounted, wide field-of-view, 3D displays (HMDs) and motion sensing systems that measure the users head and present the 360 degree illusion of being completely surrounded by the virtual world. This application may be superior to traditional distraction because it offers more immersive images due to occlusive headsets that project the images right in front of the eyes of the user and depending on the model used, block out real world (visual, auditory, or both) stimuli. VR even combines the audio, visual and kinesthetic sensory modalities (Naser et al 2012). Therefore, being the most immersive of all, it is expected to be superior to the less technologically advanced A/V distraction methods. Using the concept of immersion as a theoretical framework, researchers have begun to analyze what makes VR effective for reducing pain. Slater and Wilbur define immersion as an objective, quantifiable description of what a particular VR system can provide to a participant. Immersion is different from the subjective psychological illusion of going into the virtual world known as presence (Hoffman et al 2011). Presence is commonly referred to as the sense of being in the VE (virtual Environment) rather than in the real physical place where the person's body is actually placed. If presence levels are low, patients are not adequately immersed in the virtual world. This leads to the hypothesis that the more immersive the stimuli, the higher the presence and the larger the pain reduction will be. McCaffery and Pasero labeled this phenomenon as sensory shielding (Caffery 1999). The user is shielded from pain by the increased sensory input originating from the distraction.

The stimuli used for VR distraction are fantasy worlds, 3D virtual real life situations with high ecological validity (Andreas et al 2005). The first immersive VR software designed for pain control was named SnowWorld ([www.vr.pain.com](http://www.vr.pain.com)). In SnowWorld patients interact with Snow men, Igloo, Penguins, Woolly mammoths, and flying fish by throwing snowballs. Many features and components can be added to or removed from the equipment depending on the available budget (Hoffman et al 2011)



## CONCLUSION:

VR distraction is a clinically viable technique with a high potential to alleviate pain/anxiety associated with various dental procedures. It has proved to be effective in majority of patients and seems to be a safe technique that does not require any previous education and training. It can be used effectively in children, adolescents and adults by adjusting the images to the according developmental stages. However, still much research needs to be done to obtain a clearer picture of its full potential strength and limitations.

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