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Brenda K. Wiederhold, PhD, MBA, BCIA
Giuseppe Riva, PhD, MS, MA

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Scientific Evidence for the Effectiveness of Virtual Reality for Pain Reduction in Adults with Acute or Chronic Pain

Shahnaz SHAHRBANIAN¹, Xiaoli MA², Nicol KORNER-BITENSKY³ and Maureen J. SIMMONDS³

¹School of Physical & Occupational Therapy, Faculty of Medicine, McGill University, Montreal, CANADA

Abstract. The objective of this systematic review was to determine the level of scientific evidence for the effectiveness of VR for pain management in adults with pain. A comprehensive systematic search involving major health care databases was undertaken to identify randomized clinical trials (RCTs) and descriptive studies. Twenty-seven studies were identified that fulfilled the inclusion criteria. There was strong (Level 1a) evidence of a greater benefit from immersive VR and limited evidence (Level 2a) for the effectiveness of non-immersive VR in reducing acute pain. Moreover, there is limited evidence (Level 2a) of effectiveness of immersive VR compared to no VR for reducing chronic pain. There is currently no published study that has explored the effectiveness of non-immersive VR for chronic pain (level 5). It is concluded that VR can be recommended as a standard or adjunct clinical intervention for pain management at least in the management of acute pain.

Keywords. Virtual reality, pain, randomized controlled trials, systematic review.

Introduction

Pain is a prevalent problem in modern society and has a negative impact on psychological, physical, and social dimensions of quality of life. In the past, a major focus around pain management has centered on pharmacologic strategies, whereas the literature published during the last decade has increasingly focused on non-pharmacologic interventions. In recent years, VR has become popular in clinical research studies as an innovative distractor technique for pain reduction. Rizzo and Kim [1] defined VR as a non-invasive simulation technology that allows a user to interact with a computer-generated environment, in the three dimensions of width, height, and depth. In a series of preliminary studies, Hoffman [2-4] demonstrated that patients with severe burns using VR reported large reductions in worst pain, pain unpleasantness, and time spent thinking about pain and reported having more fun and less anxiety during various painful procedures. VR has also been used in

¹ Corresponding Author: E-mail: shahrbanian@gmail.com
different clinical settings to reduce dental pain [5], prostate thermo-surgery [6], cancer pain [7], cancer chemotherapy [8], and central post stroke chronic pain [9]. The objective of this systematic review was to determine the level of scientific evidence for the effectiveness of VR therapy on pain reduction in adults with acute (less than or equal to 6 weeks clinical pain or thermal procedural pain), or chronic (more than 12 weeks) pain stemming from various health conditions or the treatment thereof.

1. Methods

An extensive review of the scientific literature was performed by two of the investigators to identify published experimental studies focused on the effectiveness of VR therapy as an intervention for pain reduction in adults with acute or chronic pain. The following databases were searched: MEDLINE (PubMed) (1950-2008), EMBASE (1980–2008), Cochrane Central Register of Controlled Clinical Trials and Cochrane Database of Systematic Review (2008), Database of Abstracts of Reviews of Effectiveness (DARE), PsycInfo (1966–2008), CINAHL (1982 – 2008), Web of Science (1900 to 2008), Scopus (2008), and OT Seeker (1996-2008). These databases were searched using the following key terms: virtual reality, virtual environment, virtual therapy, computer simulated environment, VR exposure, user-Computer Interface, pain, and analgesia. Randomized and quasi-randomized controlled trials, crossover studies, observational studies, pre-post studies, cohort studies, and case-control studies were included. We examined the methodological quality of RCTs using the Physiotherapy Evidence Database (PEDro) Scale. PEDro results were interpreted using Foley and colleague's quality assessment [10], where studies scoring 6-to-10 were considered methodologically “high,” 4-5 were considered “fair” and ≤ 3 were considered “poor.” The level of evidence of effectiveness was determined based on Sackett [11] but adapted to include PEDro ratings [12].

2. Results

One hundred and four studies were retrieved from the databases. Four additional studies were obtained from an examination of the reference lists of the retrieved studies. Forty-three studies were excluded because they were repeated in different databases. A further 23 studies were excluded because they did not fit the inclusion criteria, and 15 because they only focused on children. Thus 27 studies including 8 RCTs, 9 randomized crossover studies, 8 case studies, 1 study with uncontrolled clinical series of cases, and 1 randomized mixed factorial design were included. The studies were grouped according to the type of VR used for the intervention – immersive (18 studies) versus non-immersive (9 studies), and duration of pain- acute (25 studies) versus chronic (2 studies). Pain intensity, unpleasant pain, and time spent thinking about pain were the most outcomes measured. The visual analogue scale, graphic rating scale, and numerical rating scale were the most common measures used to assess pain. The most typical clinical populations included burn patients undergoing wound care and patients undergoing dental treatment. Most studies
used immersive VR in comparison to non VR distraction- control, or in comparison to other
distraction therapies, such as movie distraction or hypnotic analgesia or audio distraction,
or in comparison to combination of VR plus other techniques that included standard
analgesic care plus immersive VR distraction or standard care plus TV. Only a small
percentage of adults immersed in VR experienced side effects such as nausea and motion
sickness; most studies did not report on adverse effects. There is strong (Level 1a) evidence
suggesting immersive VR is an effective intervention for decreasing pain in adults
experiencing acute pain. Limited evidence (Level 2a) indicates that immersive VR is also
effective compared to no therapy for pain relief in adults with chronic pain. Further, there is
limited (Level 2a) evidence suggesting that non-immersive VR compared to no VR- control
or other distraction techniques has more benefits for reducing acute pain. Finally, there are
no experimental studies that have investigated the effectiveness of non-immersive VR for
adults with chronic pain (level 5).

3. Discussion

This systematic review is the first to evaluate the evidence of effectiveness of VR therapy
for pain management. It was not restricted to type of pain (acute or chronic), type of VR
(immersive or non immersive), gender differences, type of study, and specific language. In
addition, data was collected in a systematic way within the framework of the Cochrane
Collaboration that was expanded to include non-RCTs. Unfortunately, the number of
studies investigating the impact of VR on chronic pain is limited. Based on the existing
evidence, VR can be recommended as an effective intervention through which patients
appear able to immerse themselves in a virtual environment world during procedural pain,
decrease their attention to painful stimuli, reduce the need for analgesia, and improve
their tolerance during painful procedures. These findings are encouraging given that VR
equipment is now widely available and requires minimal technical knowledge for use.

4. Conclusions

Based on the existing evidence, it is concluded that VR can be recommended as a standard
or adjunct clinical intervention for pain management at least in the management of acute
pain. However, the current evidence of the effectiveness of non-immersive VR for chronic
pain is limited and warrants further study.

References