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THE RISE OF PRECISION VIRTUAL REALITY INTERVENTIONS FOR CHRONIC PAIN: MECHANISMS OF ACTION, INDICATIONS, DOSING, AND EFFICACY

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Introduction

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Applications for immersive technologies have been increasingly investigated across industries with the rapid advancement of commercially available virtual reality (VR) products in the form of head-mounted display (HMD) headsets. Leveraging this technology as a therapeutic modality for chronic pain has received significant attention among researchers recognizing the profound potential VR may have to improve the lives of the chronic pain patient population. Multiple recent systematic reviews and meta-analyses have investigated virtual reality applications for chronic pain populations, describing numerous trials demonstrating clinically significant results and the overall promising nature of this modality [1][2][3]. However, clinically meaningful generalizations are limited based on the extreme heterogeneity of the VR chronic pain literature base. This includes numerous challenges including: A wide variety of chronic pain populations/conditions studied. A range of outcome measures reported (e.g., pain intensity, various psychologic and motor measures). Widely varying doses of VR treatment intervention, with doses ranging from 5 total minutes over 1 day, to 380 minutes over 19 days [3]. Diverse study designs challenging summative clinical generalizations (i.e. VR vs. standard of care, VR vs. sham-VR, VR pretest-posttest, etc.). Varying technical delivery of VR interventions, from 3D-HMD headsets to 2D-projector or screen-based setups.

Along with the significant heterogeneity between studies, no review has succinctly identified the underlying mechanisms of action (MOA) likely at play, nor identified the most clinically effective VR intervention MOA for respective chronic pain indications. VR technology and cost continue to improve, and advanced augmented and mixed reality technologies are around the corner. Pain physicians and researchers understanding precision delivery of VR interventions for chronic pain is key to maximizing successful utilization of this inevitable technology.

The purpose of this study is to analyze VR interventions for chronic pain utilizing up to date, commercially available technology (i.e. 3D HMDs) with sufficient dosage, delineate underlying mechanisms of action of VR interventions, and identify efficacy of VR MOA based on indications.

Materials and Methods

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PubMed database searches were conducted from June 2023 to August 2023 using the following search terms: (virtual reality) AND (chronic) AND (pain). A filter for “human studies” and studies published since January 2010 were applied. The search returned 185 English language articles. Each result with an available full-text, English language manuscript was reviewed. Inclusion criteria: randomized control trial or quasi-experimental trial or case series, described the use of a 3D head-mounted display (HMD) based virtual reality intervention, described patients with chronic musculoskeletal pain or chronic neuropathic pain, involved participants aged 18 and older. Exclusion criteria: virtual reality intervention administered solely in a single session or administered in total on a single day, virtual reality intervention described as an exercise rehabilitation program or physical therapy program, described patients with phantom limb pain. The reference lists for each relevant article were reviewed for further pertinent publications. As this review is devoid of patient-identifiable information, it was exempt from IRB review requirements as per Weill Cornell Medicine policy.

Results/Case Report

Results
A total of 14 studies met criteria with a total treatment group n of 327. Data extracted from each study included: study design, number of participants analyzed in the VR treatment group, chronic pain population(s), psychological comorbidity inclusion/exclusion criteria, baseline Tampa Scale of Kinesiophobia (TSK) score, dosage (total number of minutes/sessions and overall duration of VR intervention), VR intervention characteristics, VR intervention MOA, and VR treatment within-group outcomes (i.e. baseline vs. post-intervention vs. follow-up) for pain, kinesiophobia, and psychological measures.

The VR intervention MOA could be distilled into two broad but distinct categories: addressing kinesiophobia and psycho-behavioral modulation. Eight of 14 studies deployed a VR intervention addressing kinesiophobia, with a total treatment group n of 143. Six of these 8 studies, representing 83% (119/143) of treatment group participants, demonstrated statistically significant improvement in pain score from baseline to post-intervention. Eight of 14 studies utilized psycho-behavioral modulation as the underlying MOA, with a total treatment group n of 214. Five of these 8 studies, representing 80% (171/214) of treatment group participants, demonstrated statistically significant improvement in pain score from baseline to post-intervention.

Three studies investigating chronic, non-traumatic neck pain in a non-hospital setting, representing 86 total patients, reported statistically significant reductions in pain score post-VR intervention. 81% of this treatment group (70/86) maintained statistically significant group mean improvement in pain score at 3-months follow-up, as well as statistically significant improvement in Tampa Scale of Kinesiophobia (TSK) score and behavioral health anxiety measures, with all effects remaining significant at 3-month follow-up. All studies utilized addressing kinesiophobia as the MOA for their VR intervention.

Another notable result pertains to six studies investigating chronic low back pain, representing 173 total patients. These studies reported VR treatment groups demonstrating statistically significant reductions in pain score post-VR intervention. Eighty-three percent of this treatment group (143/173) also demonstrated statistically significant group mean improvement in pain interference outcome measures. Five of six studies, representing 99% of this treatment group (171/173), deployed psychobehavioral modification as a VR intervention MOA.

Discussion

Discussion

This review identified studies investigating HMD headset-based VR interventions for chronic pain, with sufficient dosing during VR intervention treatment courses. It addressed the challenge of generalizing efficacy of interventions by solely gathering data on VR treatment group arms for each study and analyzing within-group significance of relevant outcome measures. The results of this large-scale within-group analysis indicate VR interventions have significant analgesic effects, often durable at 3-month follow-ups. Furthermore, the results of this study identified two broad mechanisms of action underlying the efficacy of VR interventions for respective chronic pain indications. Notably, VR interventions addressing kinesiophobia appear to be significantly effective in non-traumatic, non-hospitalized chronic neck pain patients. Psychobehavioral VR interventions demonstrate significant efficacy in the chronic low back pain population. Studies with interventions targeting non-specific chronic pain populations did not show significant results despite use of 3D HMD headsets and sufficient dosing. It appears, as with any medical intervention, precision is key to efficacy. Along with providing actionable data for pain clinicians to incorporate VR interventions into treatment plans, the data gleaned can help guide the design of future VR interventions and clinical trials.

References

References

Mallari B, Spaeth EK, Goh H, Boyd BS. Virtual reality as an analgesic for acute and chronic pain in adults: a systematic review and meta-analysis. J Pain Res. 2019 Jul 3;12:2053-2085. doi: 10.2147/JPR.S200498.

Austin PD. The Analgesic Effects of Virtual Reality for People with Chronic Pain: A Scoping Review. Pain Med. 2022 Jan 3;23(1):105-121. doi: 10.1093/pm/pnab217.

Goudman L, Jansen J, Billot M, Vets N, De Smedt A, Roulaud M, Rigoard P, Moens M. Virtual Reality Applications in Chronic Pain Management: Systematic Review and Meta-analysis. JMIR Serious Games. 2022 May 10;10(2):e34402. doi: 10.2196/34402.

Disclosures

No

Tables / Images