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Clinical question: Can virtual reality be an effective adjunctive to conventional treatment in patients with chronic lower back pain?

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Abstract

Background: Chronic low back pain is the most prevalent chronic pain condition worldwide, accounting for 15–20% of physician visits and costing billions of dollars. Without adequate treatment, it can lead to substance use disorder and increased risk of suicide. Current treatments include non-steroidal anti-inflammatory drugs (NSAIDs), opioids, surgery, and non-pharmacological adjuncts. Evidence suggests cognitive behavioral therapy (CBT) as adjunctive therapy can improve patient commitment to treatment but not pain intensity. However, CBT is limited due to availability, location and shortage of trained personnel. Virtual reality (VR) has been growing in interest in providing affordable, digital, home-based, and self-directed CBT to address the psychosocial aspect of pain.

Methods: We searched the literature for meta-analysis, randomized control trials (RCT), and systemic reviews using the PubMed database with the terms virtual reality and chronic low back pain.

Results: The review identified 31 studies. Six were chosen that were applicable to our clinical questions, one systematic review, two meta-analysis and three RCTs. The RCTs showed that virtual reality can improve pain in patients with chronic lower back pain as an effective adjunctive to pharmacological and surgical intervention. The systemic review and meta-analysis also concluded that VR is beneficial in pain management however, due to inconsistent results and the multifactorial aspect of chronic pain.

Conclusions: Thus further research is required. The number of randomized trials, evidence on long-term application, and the efficacy of self-directed versus guided VR treatment limit our understanding of this topic.

Brief Answer:

Authors have no conflicts of interest to report.

Literature Search
Database searched: PubMed
Search Conducted: September 2023
Inclusion criteria: Recent randomized controlled trials, systematic review, meta-analysis
Exclusion criteria: Studies older than ten years, pediatric patients
Search terms: Virtual reality, chronic low back pain

Inconclusive.—The RCT, systematic review and meta-analysis show positive improvement in pain scores and benefit to mental health associated with chronic low back pain. However due to the inconsistencies in current research, additional research would be necessary.

Level of evidence of the answer: B

Keywords

virtual reality; chronic low back pain; non-pharmacological treatments

Summary of issues:

Chronic low back pain is significant as it is the most prevalent chronic pain condition worldwide.[1] Its negative impacts not only affect physical health but also mental health.[2] Chronic pain visits constitute 15–20% of physician visits and cost billions of dollars.[3,4] Without adequate control, it can often lead to substance use and increased risk for suicide.[4] Increased pharmacologic and surgical interventions pose a risk of serious side effects. Long-term NSAIDs and opioid use have been associated with gastrointestinal bleeding, arterial thrombosis, and addiction.[2] Even with these risks, the United States consumes about 80% of opioids worldwide.[3]

Non pharmacologic first-line treatments for chronic low back pain include pain education and CBT.[2] While CBT has not shown explicit efficacy in reducing pain intensity, it has a small to moderate effect in decreasing depressive symptoms and other psychosocial aspects of pain.[5] Limitations of these non-pharmacological services include availability of services, shortage of trained personnel and lack of commitment of the patients.[2]

During the COVID-19 pandemic, the desire to provide remotely deployed self-administered CBT grew. Virtual reality and its potential in immersive treatment have been on the rise to provide affordable, digital, home-based, and self-directed CBT that could seamlessly incorporate the psychosocial aspect of pain.[2,5] VR facilitates a perception of being physically present in the virtual environment and has been utilized to address the need for anxiety, depression, and pain.[3,5] VR treatment involves using headset devices that fully restrict the vision field to the content displayed inside the headset screen; auditory perception is not entirely restricted, though the corresponding device-delivered auditory content commands attention.[5] VR can provide some advantages to increase motivation and interaction, which offers treatment in a fun and attractive way.[6] In addition, it can provide distraction by focusing on external stimuli, not the body, reducing attention to pain.[6] It has been shown from multiple studies that VR is effective in managing acute pain associated with procedures and wound care.[5] This review will address the role of VR as an adjunctive non-pharmacological treatment for chronic back pain.

Summary of evidence:

In a systematic review and meta-analysis by Brea-Gomez, B. et al.,[6] randomized controlled trials exploring VR's effects on treating chronic low back pain were assessed with adults older than 18 years with chronic low back pain and VR interventions of at least four weeks

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duration. The systematic review included 14 trials from around the world from 2013 to 2021. When they compared the effects of VR to no VR, 11 of 14 studies were included in the quantitative analysis to assess for 1) pain intensity post-intervention, 2) pain intensity at the 6-month follow-up, 3) disability post-intervention, 4) kinesiophobia post-intervention, and 5) kinesiophobia at the 6-month follow-up. Kinesiophobia is the fear of movement secondary to pain.

Researchers used visual analog scales to evaluate pain intensity. When studies used the same pain scale, the mean difference (MD) was reported; the standardized mean difference (SMD) was used when the scales were different. Comparing the VR treatment group to the control group, the pain intensity post-intervention favored VR with a significant difference with SMD −1.92 (95% CI = −2.73,−1.11; p <0.00001). In addition, results significantly favored VR compared to no VR intervention SMD −1.84 (95% CI =−3.48, −0.21; p = 0.03). Results also favored VR compared to placebo (SMD −2.71; CI 95% = −3.33, −2.10; p < 0.00001) and oral treatment (SMD −0.78; 95% CI = −1.42, −0.13; p = 0.02.). Similar findings were found in pain intensity at follow-up in 6 months. No significant differences were found between VR and other interventions in disability post-intervention but did show a significant difference compared to placebo favoring VR after 12 weeks (MD −27.89; 95% CI = −30.77, −25.01; p < 0.00001). In kinesiophobia post-intervention, statistics favored VR with significant differences after 4 weeks (MD = −12.05; 95% CI = −20.13, −3.98; p = 0.003), but not at 8 weeks (MD = 3.47; 95% CI = 1.00, 5.94; p = 0.006). However, it favors VR at 6-month follow-up (MD −12.04 95% CI −20.58, −3.49; p = 0.006.) The authors reported that the systemic review had high heterogeneity in all statistical analyses.

In the systematic review by Wong et al.,[4] 17 studies were selected. Their study designs and quality scores were evaluated. Based on their evaluation, VR used as adjuvant intervention is effective in reducing chronic pain. Immersive VR showed better results than non-immersive VR. They noted inconclusive benefit for mental health related to chronic pain as many studies did not integrate this into their focus. The systematic review concludes while seeing benefit of VR in pain reduction, more future studies with well designed studies are needed to conclude the benefit of VR.

In the meta-analysis by Huang et al.,[3] 31 studies were selected and excluding juveniles, 16 studies involving only adults showed decreased pain score based on visual analogue scale by 1.34 lower than control group (Weighed Mean Difference (WMD) of 21.34; 95% CI 21.66 to 21.02; P , 0.001) and without heterogeneity (I^2 = 0.0%; P = 0.488). The analysis showed statistical significance in reduction in anxiety (WM<D 21.3; 95% CI 21.86 to 20.75; P < 0.001), lower pain unpleasantness (WMD 21.3; 95% CI 21.86 to 20.75; P <, 0.001), and time spent thinking about pain (WMD 21.83; 95% CI 22.77 to 20.90; P < 0.001) associated with VR treatment compared to the control group. Similar conclusion was determined that further research would be required.

In an RCT by Garcia, L. et al.,[5] 179 patients were followed for 56 days. Patients were assigned EaseVR, an immersive pain relief skill VR program, or sham VR, which was 2D nature content through the headset. The patients participated electronically in surveys collected at intervals during pretreatment, biweekly during treatment, and on day 56. Data showed a nonsignificant difference between patient participation in EaseVR (5.4 sessions a week) and sham VR (6.0 sessions per week). Patient satisfaction significantly favored using the EaseVR compared to sham VR (P<0.001).

Although both treatment groups had a significant decrease in average pain intensity over the time frame of the experiment (P<0.001), the EaseVR group had lower pain intensity with P=0.001 and Cohen d=0.49 and 42.8% pain reduction compared to 25.1% for ShamVR. Similar findings were noted in assessing pain interference with activity P=0.004 with a 51.6% reduction in EaseVR and 32.4% for Sham VR and mood P=0.005 with 55.7% for EaseVR and 40.04% in Sham VR, respectively. Both groups showed improved symptoms such as pain catastrophizing, pain self-efficacy, and pain acceptance but did not show statistical significance. Opioid use and analgesic use were not significantly changed during the trials and remained at baseline. On follow up post treatment up to three months by Garcia L. et al.,[1] these patients retained the benefits of VR treatment compared to the shamVR control group. When compared to end of treatment effects to post treatment, EaseVRx had lower pain intensity to sham VR (P=0.0046; Cohen’s d=0.43) and pain interference (P=0.0071; Cohen’s d=0.41).

Similarly, Groenveld et al.[2] conducted an RTC with a study similar to that of Garcia et al. with the difference of selecting patients from a smaller population from a pain clinic and a control group not receiving sham VR for the duration of the 4-week study. Forty patients answered on a short form-12 questionnaire. The intervention VR group versus control group results showed no significant mean difference between physical mean difference (−2.56; 95% CI = −5.60, 0.48; p=0.96) and mental scores (−1.75; 95% CI = −6.04, 2.53; p=0.41). The intervention group did note an improvement in the daily worst-experience pain score and a decrease in opioid use. Reduction in opioid use was noted in the VR group from 47% at least once weekly in week 1 to 28% in week 4, while the control group remained at 37%. However, no changes were seen in the use of paracetamol or NSAIDs. At the 4-month follow-up, patients showed significant reduction in effect on daily least experienced pain score (F [1, 30.069] = 11.5, P = 0.002) compared to control.

See table 1 for summary of findings of the above articles.

Conclusion:

The results from the literature suggest VR can be an adjunctive therapy to pharmacologic treatment for chronic low back pain by evidenced improvements in pain intensity compared to the control group. While data suggest positive outcomes in the use of VR, the inconsistent data between RCTs suggest numerous variables must be considered along with the multifactorial cause of pain, including the subjective nature of pain in individual patients. Based on current data, further research is required. Virtual reality is becoming more affordable and accessible for patients. This provides a safe and potentially effective method to overcome barriers to care and warrants future research to study the impact of VR in pain management along with current adjuvants of pain treatment.

Acknowledgments

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References

1. Garcia LM, Birckhead BJ, Krishnamurthy P, et al. Three-month follow-up results of a double-blind, randomized placebo-controlled trial of 8-week self-administered at-home behavioral skills-based virtual reality (VR) for chronic low back pain. The Journal of Pain. Published online December 2021. doi:10.1016/j.jpain.2021.12.002
2. Groenveld TD, Smits MLM, Knoop J, et al. Effect of a Behavioral Therapy-Based Virtual Reality Application on Quality of Life in Chronic Low Back Pain. Clin J Pain. 2023;39(6):278–285. Published 2023 Jun 1. doi:10.1097/AJP.0000000000001110 [PubMed: 37002877]
3. Huang Q, Lin J, Han R, Peng C, Huang A. Using Virtual Reality Exposure Therapy in Pain Management: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Value in Health. Published online October 2021. doi:10.1016/j.jval.2021.04.1285
4. Wong KP, Tse MMY, Qin J. Effectiveness of Virtual Reality-Based Interventions for Managing Chronic Pain on Pain Reduction, Anxiety, Depression and Mood: A Systematic Review. Healthcare. 2022;10(10):2047. doi:10.3390/healthcare10102047 [PubMed: 36292493]
5. Garcia LM, Birckhead BJ, Krishnamurthy P, et al. An 8-Week Self-Administered At-Home Behavioral Skills-Based Virtual Reality Program for Chronic Low Back Pain: Double-Blind, Randomized, Placebo-Controlled Trial Conducted During COVID-19. Journal of Medical Internet Research. 2021;23(2):e26292. doi:10.2196/26292 [PubMed: 33484240]
6. Brea-Gómez B, Torres-Sánchez I, Ortiz-Rubio A, et al. Virtual Reality in the Treatment of Adults with Chronic Low Back Pain: A Systematic Review and Meta-Analysis of Randomized Clinical Trials. Int J Environ Res Public Health. 2021;18(22):11806. [PubMed: 34831562]

Table 1 –

Summary of Study Findings

Study	Type	Background	Significant statistical findings	Non statistical significance findings
Garcia LM, Birckhead BJ, Krishnamurthy P, et al.	Randomized control trial	179 patients. Electronic surveys at pretreatment, biweekly during treatment and on day 56. EaseVR vs. Sham VR	Pain reduction P=0.001 and Cohen d=0.49 Ease VR: 42.8% Sham VR: 25.1% Improvement in pain interference with activity P=0.004 Ease VR: 51.6% Sham VR: 32.4% Mood improvement P=0.005 Ease VR: 55.7% Sham VR: 40.04% 3 Month follow up EaseVR vs. Sham VR Lower pain intensity (P=0.0046; Cohen's d=0.43) LowerPain interference (P=0.0071; Cohen's d=0.41)	Improvement in: pain catastrophizing pain self-efficacy pain acceptance
Groenveld, Smits MLM, Knoop J, et al.	Randomized control trial	41 patient, 1 withdrawn. Short form-12 questionnaire at 4 weeks and at 4 month follow up. VR vs no VR treatment	4 weeks No significant mean difference Physical score (−2.56; 95% CI = −5.60, 0.48; p=0.96) Mental scores (−1.75; 95% CI = −6.04, 2.53; p=0.41) 4 month Significant reduction in daily least experienced pain score P = 0.002 compared to control.	Reduction in opioid use was noted in VR group from 47% at least once weekly in week 1 to 28% in week 4 while control group remained at 37%.
Brea-Gómez B, Torres-Sánchez I, Ortiz-Rubio A, et al.	Systematic review Meta-analysis	11 of 14 RTC around the world from 2013–2021. Assessed for 1) Pain intensity post intervention 2) Pain intensity at 6 month follow up 3) Disability post intervention 4) kinesiophobia post intervention 5) kinesiophobia at 6 month follow up	Pain intensity post-intervention favored VR with significant difference with SMD −1.92; 95% CI = −2.73,-1.11; p <0.00001. similar finding at 6 month follow up SMD −6.34; 95% CI = −9.12,-3.56; p <0.00001 VR with physiotherapy was compared to no VR with physiotherapy favored VR therapy SMD −3.26; 95% CI = −5.08, −1.44; p = 0.0004. After 12 weeks, VR and other interventions in disability postintervention compared to placebo favoring VR (MD −27.89; 95% CI = −30.77, −25.01; p < 0.00001). Favor of VR with significant differences for kinesiophobia after 4 weeks (MD = −12.05; 95% CI = −20.13, −3.98; *p* = 0.003). but not at 8 weeks (MD = 3.47; 95% CI = 1.00, 5.94; *p* = 0.006). However, again favors VR at 6 month follow up (MD −12.04 95% CI −20.58, −3.49; p = 0.006.)	No significant differences between seen VR alone vs physiotherapy with or without VR. No significant differences were found between VR and other interventions in disability post intervention. High heterogeneity in all statistical analysis.
Wong KP, Tse MMY, Qin J.	Systematic review	PRISMA guideline 1) Search term: Chronic pain and virtual reality. 2) Dates January 2010-December 2021 3) 7 RTC, 7 quasi experimental study, 1 controlled study, 1 case series, 1 before and after study	Favorable for VR VR effective as adjuvant intervention in reducing chronic pain. Immersive VR showed better results than non-immersive VR.	Inconclusive benefit for mental health related to chronic pain as many studies did not integrate this into their focus. More future studies with well designed studies are needed to conclude the benefit of VR.

Study	Type	Background	Significant statistical findings	Non statistical significance findings
Huang Q, Lin J, Han R, Peng C, Huang A.	Systematic review Meta-analysis	16 of 31 studies selected involve adults and 12 involving juvenile population	Decreased pain score based on visual analogue scale by 1.34 lower than control group (WMD 21.34; 95% CI 21.66 to 21.02; P .001) and without heterogeneity (I^2 = 0.0%; P = .488). Both juvenile and adults in VR compared to control: Reduction in anxiety (WMD 21.3; 95% CI 21.86 to 20.75; P , .001) Lower pain unpleasantness (WMD 21.3; 95% CI 21.86 to 20.75; P , .001) Time spent thinking about pain (WMD 21.83; 95% CI 22.77 to 20.90; P , .001)	Pain tolerance VR and the control (WMD 0.13; 95% CI 210.34 to 210.59; P = .981) More research needed