Chronic Pain Management in Cancer: An exploratory analysis of electroencephalograph activity during virtual reality pain distraction therapy



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INTRODUCTION

Guided mindfulness meditation delivered using virtual reality (VR) is a promising adjunctive approach to chronic pain management.

Electroencephalography (EEG) may help further explain potential neurological changes occurring in the brain during VR activity.

OBJECTIVES

- 1. To assess how EEG waveforms changed during and after a VR-guided meditation experience in participants with cancer-related chronic pain.
- 2. To explore techniques for recording EEGs during VR experiences.
- 3. To explore the association between pain and EEG waveform power.

SETTING

Cancer patients with chronic pain currently enrolled in a randomised controlled trial to explore the value of VR as an adjunctive therapy pain management were recruited.

Participants:

- Purposively selected from an ongoing trial involving VR-based mindfulness meditation for chronic cancer pain
- Aged ≥16 years, with past or ongoing cancer treatment
- Chronic pain with Numerical Rating Scale (NRS) of ≥ 4
- Able to use VR- guided meditation application
- Able to communicate in English
- Had previously experienced a pain reduction ≥ 1 on the NRS during the trial

ACKNOWNLEDGEMENTS

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METHODS

Equipment and Procedures

- 1. Used a 64-channel EEG in 10-20 configuration.
- 2. Exposed to a single session with 8 min rest : 30 min VR meditation : 8 min rest.
- 3. EEG power was compared between each condition using cluster-based permutation testing.
- 4. Topographical analysis and coherence analysis.
- 5. Pain was assessed verbally at 5 time points and analyzed using repeated measures correlation.





Timeline of recording – rest and meditation conditions. NRS: numerical rating scale



Recording computer screen capture









Box plot of power level



Topography of power spectrum



Power increased in the beta and gamma bandwidths during the VR therapy (P<.025).



Observed coherence changes primarily:

- In the theta, alpha and gamma bands
- P<.0025

Coherence difference between channel pairs



RESULTS

• Between the frontal, parietal, and occipital cortices

RESULTS

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No significant relationships between pain scores and EEG power variations were observed.

Numerical rating scale scored after each condition

Participant	NRS score				
	Pre	Med1	Med2	Med3	Post
S01	4	2	2	2	1
S02	4	3	0	0	1
S03	7	4	7	5	3
S04	6	5	4	4	3
S06	5	6	5	4	5
S07	3	5	4	2.5	4
S10	3	3	2	2	2

CONCLUSIONS

- The study demonstrated specific VR-related EEG changes during the VR therapy.
- Provides novel EEG recording and analysis methods that can be used to investigate neurophysiological changes in VR pain applications
- These approaches may guide further studies to explore and identify brain regions and wave bands with respect to VR therapies for chronic pain.

REFERENCES

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