

Let's Relax! An Immersion Virtual Reality Relaxation Intervention for Quality of Life Improvement of Cancer Patients

Sant Chawla³, Bryan Li^{2*}, Seiya Liu⁴, Erlinda Gordon³, Seniha Ipekci², Seiji Liu², Steven Siegel¹, Mika Liu⁵

¹University of Southern California Dept of Psychiatry, Los Angeles, CA, USA

²IFGvr Inc, Los Angeles, USA

³California Sarcoma Cancer Center, Los Angeles, CA, USA

⁴Harvard University, Cambridge, MA, USA

⁵Stanford University, Stanford, CA, USA

*Corresponding author: Bryan Li, IFGvr Inc 11301 W Olympic Blvd, #558, Los Angeles, CA 90064, USA.
Tel: +14245353123; Email: bryan@ifgvr.co

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Abstract

Background and Significance: Interventions that reduce mental distress and enhance positive feelings are crucial for improving quality of life and, conceivably, overall survival of cancer patients. One remedy is the immersive virtual reality relaxation (VR-R) environments to inspire an emotion-focused coping mechanism in cancer patients.

Patients and Methods: Twelve normal volunteers and 50 cancer patient volunteers underwent VR-R training and used the Let's Relax!TM VR-R environment/s for 5-30 minutes. VR-R is a software-based simulation, which allows an individual to be placed inside an experience, hearing and interacting with stimuli that correspond with visual images of an artificial world. After the immersion VR-R intervention, patients reported on their experience during the VR-R intervention by answering a QoL questionnaire created by Cancer Center of Southern California/Sarcoma Oncology Center, University of Southern California Dept of Psychiatry, and IFGCURE Inc.

Results:

Safety Analysis: Ten of 12 normal volunteers had no adverse reactions. Eight of 50 (16%) patients experienced mild motion sickness as the only adverse event associated with its use. Forty-one of 50 (82%) patients had no adverse reactions.

Efficacy Analysis: Table 1 shows the emotions that patients reportedly experienced during VR-R intervention. Table 2 shows a point scoring system using yes/no questionnaire or a modified EORTC QLQ C-30 v3 questionnaire.

Conclusion: Taken together, the data support the premise that Let's Relax!TM VR-R intervention is safe and may be efficacious in improving symptom distress and quality of life of cancer patients. A Phase 1/2 study is planned to evaluate the safety and efficacy of the Let's Relax!TM VR-R intervention in improving quality of life in a larger number of cancer patients. A prospective study is planned to confirm that VR-R intervention is safe and effective in reducing symptom distress and improving quality of life in cancer patients undergoing cancer treatment.

1. Abbreviations and Keywords: Cancer; Head Mounted Display (HMD); Oncology; Quality of Life (QOL); Virtual Environments (VE); Virtual Reality (VR); Virtual Reality Relaxation (VR-R)

2. Introduction

Cancer is a leading cause of morbidity and mortality in adults; one of every two men and one of every three women in the United States will develop cancer in their lifetime [1]. Cancer afflicts about 1.69% of the population and there are about 508,000 cancer related deaths each year in the United States alone [2, 3]. An increasingly important aspect of oncology is to evaluate quality of life (QOL). In one study with 768 cancer patients, they found that 82% of them were on the below average category on the QOL questionnaire [4]. Reduced quality of life, anxiety and distress may affect the patients coping abilities with a cancer diagnosis or treatment [5]. The main problems of long-term cancer survivors are in the areas of social/emotional support, health habits, spiritual/ philosophical view of life and body image concerns [6, 7]. Over the past few years, researchers have focused on efforts to alleviate stress and anxiety among cancer patients. As a result of chemotherapy, patients with cancer frequently experience changes in mental state, manifested as feelings of depression, helplessness, anxiety, and difficulty in concentrating [6]. There are certain risks that come with different levels of distress and reduced quality of life like trouble with daily living activities, depression or other mental problems and physical symptoms such as fatigue and pain [4]. In addition, because of associated chemotherapy-related distress symptoms, patients often have difficulty adhering to the prescribed schedule [8, 9]. Developing interventions to assist people to better tolerate cancer treatments and, therefore, increase their chances for survival is an oncology priority and a major focus of oncology research. Studies have focused on interventions and coping strategies such as humor, relaxation, music, imagery, and VR [10-12].

Recently researchers have been exploring the efficacy of virtual reality to help patients develop coping strategies. Virtual reality (VR) utilizes advanced technologies to create virtual environments (VE) that allow patients to be immersed in an interactive, simulated world [13]. These advanced systems interact at many levels with the VE, stimulating sights, sounds, and motion to encourage immersion in the virtual world to enhance distraction from pain. In a controlled study, adult burn patients undergoing physical therapy reported less pain while involved in VR than those that only participated in standard physical therapy [14]. Another study showed that VR is effective in reducing pain in children with cancer, as chemotherapy-related symptom distress was reduced significantly immediately after using VR during treatment [11].

Prior research [15] suggests that people who have the capability or tendency to become involved or immersed [16] as well as have a distancing coping style will benefit easily from distraction interventions [17]. Perceived benefits included distraction, entertainment, and relaxation and induced positive emotions [18]. In addition to an enriched patient experience, it can provide tangible clinical benefits, and manage their anxiety [19]. Furthermore, VR can provide additional benefits such as: 1) time distortion: positive modification of time perception; 2) natural relaxation, non-pharmacologically induced; 3) higher patient satisfaction with treatment; and 4) modified perception of painful stimuli and anxiety-triggering environment [20]. The long-term benefits of VR have been reported to include improvement in QoL and duration of survival. Specifically regarding IFG Cure VR environments, chronic illness patients who come to a facility frequently or have long treatment hours can benefit from Virtual Reality. They become empowered in the virtual world when they can soak in the sun's rays, walk powerful strides, submerge themselves underwater, stroll amongst the tall bamboo in a Japanese forest, listen to rain fall, and make a pit stop at a teahouse and mix tea themselves – in other words, patients benefit from the engaging, interactive

virtual experiences which place them in worlds and situations beyond just their bed. IFGCURE customized contents VR-R allow patients to visit places and enjoy environments with powerful acoustic and visual cues for not just improved mental wellness but also empowerment. Patient empowerment – in a virtuous cycle – translates into an improvement in their mental wellbeing, their willing to live, and ultimately, their quality of life. The current study tests the safety and potential efficacy of the use of a VR intervention in improving quality of life of chemotherapy patients using a modified EORTC QLQ. A post- intervention assessment was conducted to evaluate potential efficacy of the VR intervention.

3. Materials and Methods

3.1. Participants

Each participant provided informed consent and permission to publish their de- identified results. A sample size of 50 was determined to be sufficient to test the effectiveness of the intervention. The 50 subjects were randomly selected. Subject enrollment occurred over three months beginning in March 2018. Participants were assigned, based on patient preference, to receive or not to receive the VR intervention. All participants received “standard of care” plus VR intervention. There was no exclusion

criteria beyond patient consent to the process and the ability to operate an Oculus Rift HMD. All patients were undergoing chemotherapy treatment at the time. There was no control, as the study aimed to test safety and subjective patient experience rather than comparing the VR-R to treatment as usual. The average age of participants were 47.33 years (SD=16.21, N=50).

3.2. Equipment

The study intervention utilizes an immersion virtual reality (VR) technology as a therapeutic tool designed by IFGCURE Inc. In the IFGCURE VR, a computer- simulated technique, allows an individual to hear and feel stimuli that correspond with a visual image. The VR equipment consists of the Oculus Rift Head Mounted Display (HMD) that enables play of an interactive engaging scenario(s) or game that patients can experience from a first-person perspective (i.e., upon entering the IFG virtual wellness center™ interactive scenarios, participants are transported into a virtual, 3D world). And within this virtual world, a full-immersion VR-Relaxation (VR-R) application, an interactive video simulates an environment (e.g., beach) for an individualized first-person engagement of the activity selected for relaxation (**Figure 1**).



Figure 1: VR Relaxation environment with a beach setting.

Individuals in the study wear a 470g (1.04 lb.) head-mounted device (Oculus Rift Consumer Version 1) which projects an image with corresponding sounds; an interactive beach scenario, developed and created as a relaxation therapy component (**Figure 2**).



Figure 2: Setup of VR headset with remote controls.

The headset is integrated with headphones providing real-time 3D audio effects. The sense of touch is involved through Oculus touch controllers. The video display is PenTile OLED, 2160x1200 (1080x1200 per eye) at 90 HZ, 6DOF (3-axis rotational tracking + 3-axis positional tracking) through USB-connected IR LED sensor, which tracks via the “constellation” method. Connectivity is HDMI 1.3, USB 3.0, and USB 2.0 via a PC. The duration of the scenario is up to 15 minutes or more depending on the interaction of the participant. The Oculus Rift was connected to a VR ready laptop or desktop computer. Because the goal of the intervention was to relax the patients, participants decided the duration of the VR-R experience.

3.3. VR Treatment Protocol

The study was conducted at the Cancer Center of Southern California/ Sarcoma Oncology Research Center (SORC). Each patient underwent VR-R training for about 5 minutes to learn the controls and become comfortable in the environment. Once patients felt comfortable with the controls, they were prompted to explore the beach environment for 15-30 minutes depending on their preference. Participants used the VR during, before or after the chemotherapy treatment. Immediately after each VR-R treatment, patients were instructed to fill out a modified EORTC QLQ. The research coordinator collected the questionnaires once completed.

3.4. Measures

We used a modified EORTC QLQ C-30 v3 to validate the efficacy of the intervention for improving quality of life. The modified questionnaire includes 20 items related to physical symptoms, VR experience, and emotional issues. Questions 13-20 were on 4-point Likert scale. Each item was coded as response categories: “Not at all”, “A little”, “Quite a bit”, and “Very much”. Scores were on a 7-28 range and scores over 24 were classified as excellent. Some questions (Q. 1-2, 5-12) were scored separately on a yes or no scale. Scores were on a 0-10 range and scores over 8 were classified as excellent. The scores were assigned ratings as “Excellent”, “Good”, “Satisfactory” and “Poor” with higher scores corresponding to a positive VR-R experience. The Evaluation of VR Intervention is an open-ended questionnaire that was used to elicit subjects’ evaluation of the intervention and responses about the ease of the equipment use, relaxing features, effectiveness of VR for relaxation, safety and desire to use VR during future treatments.

4. Results

Descriptive statistics were used to analyze response to the quality of life questionnaire. 50 patient volunteers have tested our environments, with 40 filling out both the weighted questionnaire that IFGCure adapted from the EORTC QLQ- C30 v3 as well as the original questions created to measure VR efficacy. We also tested whether the QLQ scores were correlated with the Y/N questionnaire. There was a statistically significant positive correlation

between QLQ and the Y/N scores, $r=0.36$, $n = 30$, $p < .05$, two-tailed. We found that there was a moderate degree of correlation 0.36; most likely due to the restricted range of both scores. The results from both scales are as follows:

Originally created Y/N questions

- Average Score = 8.1/10 (0-10 range scale), Rating: Excellent Modified EORTC QLQ-C30 v3 questions
- Average Score = 26.05/28 (8-28 range scale), Rating: Excellent

QLQ scores ranged from 22-28. The mean score was 26.05 (SD = 1.62). Eight of 50 (16%) patient's experienced mild motion sickness as the only adverse event associated with its use. 95% of patients indicated that the VR-R intervention reduced anxiety and was relaxing. Of the two patients who reported that the VR-R did not relax them, one of them had difficulty with learning the controls, while the other said they would prefer something more competitive such as video games. Overall, most patients recorded

improved quality of life (78.4%). Some patients indicated that they felt bored while exploring the VR-R environment (28%). However, there was no significant mean difference between age and boredom with the VR. It was also assumed that younger patients might enjoy the overall VR experience more, but there was no significant difference between younger and older patients. When comparing the average scores of the VR-R experience Y/N questionnaire, patients who experienced motion sickness (M =6.14) had less average mean indicating that lower scores may be due to motion sickness (M = 8.47), $t(6.93) = -1.77$, $p < 0.05$. People who reported that VR-R was relaxing, and reduced anxiety had a slightly higher total QLQ score (M = 26.16, SD= 1.54) compared to people who reported that it did not relax them or only relaxed them a little bit (M = 24.00, SD=1.28), $t(36) = 8.27$, $p < 0.05$, 95% CI =1.07. Our results suggest that positive feelings and increased relaxation are correlated with a positive perception of quality of life (Table 1, 2).

Patient Reported Experience during VR-R Intervention	# Patients/Total #	% Patients
Felt relaxed	46/50	92
Reduction in anxiety	45/50	90
Reduction in fear	44/50	88
Reduction in depression	46/50	92
Had positive feelings	40/50	80
Reduction in tension*	39/40	98
Reduction in fatigue*	39/40	98
Will use VR-R again	44/50	88
Will use VR-R at home*	30/40	75
Would use as adjunct to chemotherapy	39/50	78
*Queries were added to second group of 40 patient volunteers		

Table 1: Patient Reported Experience during VR-R Intervention.

Y/N Score		
Excellent	30	75.00%
Good	6	15.00%
Satisfactory	2	5.00%
Poor	2	5.00%
EORTC QLQ Score		

Excellent	37	92.50%
Good	3	7.50%
Satisfactory	0	0.00%
Poor	0	0.00%

Table 2: Y/N Score and EORTC QLQ Score results.

5. Discussion

The current feasibility of the study shows encouraging preliminary evidence for the 50 patients who received VR-R intervention. 89.7% of patients indicated that they would use the VR-R treatment as an adjunct with chemotherapy, and also to use at home. 16% of patients reported mild motion sickness, and no patients reported significant adverse responses. Mild motion sickness for first time VR users can be normal, as the effect comes from sensory mismatch (among others)—your brain tells you that you're walking around, but your body tells you that you're seated. This feeling of motion sickness can be improved through familiarity with VR and feature tweaks, such as slower walking speeds within environments. The current study has some limitations that should be considered. The training in the study was limited with a short amount of time, and long term follow ups were not made. One major complaint patients reported was boredom, which can be addressed by introducing more activities to the environments or having a selection of environments. Another explanation for boredom could be that it was being conflated with inexperience of using the Oculus HMD with the environment. A short tutorial prior to usage could get patients quickly up to speed, thus improving engagement through knowledge of VR controls. Despite these limitations, the current study is an important initial exploration of the safety of VR for chemotherapy patients and its efficacy in inducing positive feelings and improved perception of quality of life. Immersive Virtual reality is becoming widely available in the market and more affordable, thus making it possible for a much wider number of patient populations to access it for treatment. Wireless VR headsets which are currently in development may make it easier for patients to fully immerse themselves. The Oculus Go, which is a standalone wireless headset without positional tracking, was released in May 2018 for \$199. The Oculus Quest, which is a standalone wireless headset with full positional tracking, will be released in the spring of 2019 at a \$399 price point. This dramatically opens up the use of VR for patients who can't afford to purchase an expensive gaming laptop to go along with the \$399 Oculus Rift wired headset.

Additional research and development are needed to assess the long-term outcomes of the VR-R intervention.

6. Conflicts of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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