Protocol Summary

PRINCIPAL/OVERALL INVESTIGATOR: Dr. Robert Edwards, Ph.D.

Co-Investigators: Aliza Spielman OTD/s.

PROTOCOL TITLE

The Feasibility & Effectiveness of Virtual Reality in Reducing Pain for Older Adults with Knee Osteoarthritis

FUNDING

- None

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SPECIFIC AIMS

1. The purpose of this project is to evaluate the feasibility and effectiveness of VR as a treatment option for older adults with chronic osteoarthritic knee pain.
2. Aim 1: Implement a pilot study and collect data on the feasibility of VR and its effects on pain for older adults with chronic osteoarthritic knee pain.
3. Aim 2: Analyze the feasibility of VR for this population, including looking at simulation sickness factors and drop out reasons/rates, and its impact on chronic pain immediately prior to and immediately post intervention, as well as a few days post intervention.
4. Sub-study Aim 1: The aim of this sub-study is to compare the effectiveness of a virtual reality meditation session and a non-immersive meditation session for improving pain, affect, and physiological vital stats in adults with fibromyalgia.
5. Sub-study Aim 2: We hypothesize that the VR meditation session will facilitate greater improvements in pain, affect, and physiological vital stats as compared to the non-immersive meditation intervention.

BACKGROUND AND SIGNIFICANCE

Thirty percent of older adults in the United States report experiencing chronic pain, with 41% of this subset of the population experiencing chronic joint pain (NIH Pain Consortium, n.d.). Knee osteoarthritis (OA) affects 37% of individuals aged 60 years or older who participated in the National Health and Nutrition Examination (Sharma, 2021). This condition typically involves pain, stiffness, reduced joint motion and muscle weakness, and chronic pain that can have profound effects on physical function, psychological parameters, and overall quality of life. Past studies at the PMC have looked at the physiological mechanisms involved with chronic knee OA and the older adult population, the site has had limited funding to research nonpharmacological treatments such as virtual reality. Virtual reality has been shown to be feasible for a variety of populations, including young people with autism experiencing specific phobia, pediatric

burn patients, and young adults (Maskey et al., 2019; Hoffman et al., 2014, Sakhare et al., 2019). However, there is limited evidence on the feasibility of VR for treating pain for the older adult population. This study aims to study they effectiveness of VR for chronic pain for older adults and is necessary to determine best methods to feasibly integrate VR into clinical practice.

Sub-study:

Fibromyalgia (FM) is a debilitating rheumatological syndrome which affects millions of adults in the United States. The condition presents with widespread chronic muscular pain and reduced pain thresholds (CDC, 2020). Additional symptoms that often accompany FM include fatigue, insomnia, and negative affect. As with knee OA, the chronic pain that is caused by FM can have significant effects on physical function, psychological parameters, and overall quality of life. Just as VR distraction may be a useful tool for clients experiencing chronic knee OA, the same principles apply for pain management for those with FM. Previous research has demonstrated that affect was improved for clients with FM who participated in a 10-minute VR mindfulness session (Botella, et al, 2013). Such findings highlight the potential benefits of VR and mindfulness meditation for clients with FM. There is a great deal that remains unknown about the effectiveness of these pain management techniques. This pilot study will examine and compare the effectiveness of combining VR and meditation for improving symptoms of FM in adults.

RESEARCH DESIGN AND METHODS

We will recruit 25 older adults with knee osteoarthritis from Brigham and Women's Hospital (BWH) to obtain 20 subjects with complete data collection. The sub-study will enroll 25 adults with fibromyalgia from BWH.

Inclusion Criteria

1. *Describe the criteria that define who will be **included** in the study as a numbered list:*
    1. Adults over the age of 60 years old (no upper limit)
    2. Diagnosis of chronic knee osteoarthritis with pain in at least one knee as primary condition
    3. English-speaking
    4. Willing and able to visit the Brigham and Women's Pain Management Center site to participate in the study

Exclusion Criteria

1. *Describe the criteria that define who will be **excluded** in the study as a numbered list:*
    1. Received steroid injection within 2 weeks of VR session
    2. Unwilling to put on VR headset
    3. Diagnosed seizure disorder
    4. Cognitive impairment
    5. Hearing/visual deficit
    6. Active, contagious skin infection

7. Eye infections
8. Has a pacemaker or defibrillator
9. Has a hearing aid

Sub-study:

Inclusion Criteria:

1. Adults ages 18 and older (no upper limit)
2. Diagnosis of fibromyalgia with a minimum baseline pain level of 3 on an NPRS
3. English-speaking
4. Willing and able to visit the Brigham and Women's Pain Management Center site on two separate occasions to participate in the sub-study

Exclusion Criteria:

1. Unwilling to put on VR headset
2. Experience a seizure in the last 5 years
3. Cognitive impairment
4. Hearing/visual deficit
5. Active, contagious skin infection
6. Eye infections
7. Has a pacemaker or defibrillator
8. Has a hearing aid
9. History of myocardial infarction or other serious cardiovascular condition
10. Current peripheral neuropathy

Study Design:

Potential subjects that are interested in the study will be contacted, research staff will describe the study and go through a phone screen to make sure the subject is eligible to participate. The day before the visit the subject will be contacted and will be read the Research Participant COVID-19 Screening Questionnaire. If they answer "Yes" to any questions between 2-5 they will need to contact research staff and reschedule their session time.

Baseline Surveys

At the in-person visit the participant will complete the following baseline questionniares collected via paper and pencil or REDCap, demographics, brief medical history, past experience with VR, the Pain Catastrophizing Scale (PCS),Survey of Pain Attitudes (SOPA), the Positive and Negative Affect Scale (PANAS), the PROMIS Emotional Distress Short Form, and the Brief Pain Inventory-Short Form. Answering the surveys will take 10-20 minutes.

Virtual Tasks

Participants will engage and follow along with a 10-20 minute guided meditation through the VR. The meditation program may include simulated movement, relaxing music, and the voice of a meditation guide. The research team member will supervise the session,

ensuring safety of the subject is maintained.

Post-Intervention Surveys

After the intervention, the subject will spend about 10-20-minutes filling out post-intervention questionnaires via paper or electronically via REDCap. The questionnaires include, the subject's VR experience, the User Engagement Scale, the Igroup Presence Questionnaire, the Simulator Sickness Symptoms, the Meditation Experience Questionnaire, 2 Numeric Rating Scale for pain, the PANAS, and the Patient Global Impression of Change (PGIC). Then, we will ask a short set of open-ended questions related to overall experience with the VR and meditation, feedback about the session, and willingness to utilize this intervention again. We will audio tape the responses.

Follow-Up Questionnaires

Prior to ending the session we will determine if the subject prefers to complete the follow-up questions by phone or by electronic questionnaire. Within a few days after the intervention, we will contact the participant via their preferred method to complete the surveys at home. These surveys include, the BPI-SF, the PGIC, the PANAS, the PROMIS Emotional Distress Short Forms for anxiety, depression and anger, the PCS. If we have not heard from subject within 24 hours after sending the follow-up surveys, we will contact participants to remind or assist them with completing follow-up questionnaires. These surveys will take about 10-20 minutes to complete.

Sub-study Design:

Potential subjects that are interested in the study will be contacted, research staff will describe the study and go through a phone screen to make sure the subject is eligible to participate. The day before the visit the subject will be contacted and will be read the Research Participant COVID-19 Screening Questionnaire. If they answer "Yes" to any questions between 2-5 they will need to contact research staff and reschedule their session time

Pre-intervention Tasks

Upon completing the informed consent portion, vitals will be collected. Heart rate (HR) and blood pressure (BP) will be measured. Participant will complete the following surveys, A pain numerical rating scale (NRS) and the Pain Catastrophizing Scale (PCS) will all be used to evaluate the participants' pain levels and their perceptions of pain. The Brief Pain Inventory-Short Form and the Fibromyalgia Impact Questionnaire both assess the influences pain has on their lives. Psychosocial factors will be measured using the Positive and Negative Affect Scale (PANAS) and the PROMIS Emotional Distress Short Form for anxiety, depression, and anger.

Quantitative Sensory Testing (QST):

QST measurements will include pressure pain sensitivity assessed using an analog algometer with a 1-cm^2 rubber probe (FPK20, Wagner Instruments, Greenwich, CT, USA)

to quantify pressure pain thresholds (PPT) on the bilateral trapezius muscles and temporal summation in triplicate using a 40 g Neuropen Neurotip (Owen Mumford, Oxfordshire, United Kingdom) a train of 10 identical stimuli (1 Hz) using a metronome for timing.

Virtual Task

Participants will engage and follow along with a 10-20 minute guided meditation through the VR. The meditation program may include simulated movement, relaxing music, and the voice of a meditation guide. The research team member will supervise the session, ensuring safety of the subject is maintained.

Non-Immersive Meditation

For this session, participants will be seated facing a screen which will display the meditation imagery. They will engage and follow along with a 10-20 minute guided meditation. The meditation program will include relaxing visuals and music, and the voice of a guide.

Post-Intervention Surveys

Immediately following completion of the meditation sessions, vital signs will be taken for a second time (HR and BP). QST will then be performed for a second time. Three surveys will relate to the VR or non-immersive meditation experiences, the User Engagement Scale (UES), the Simulator Sickness Questionnaire (SSQ), and the Meditation Experience Questionnaire (MEQ). The participant will conclude by completing two questionnaires which are identical to some of the pre-intervention ones. Those are the pain numerical rating scale (NRS) and the PANAS.

FORESEEABLE RISKS AND DISCOMFORTS

Risks from VR:

Contact with objects: Participants' vision is occluded by the Virtual Reality (VR) headset. In general, they will perform the VR sitting, but the program may prompt them to move their arms and/or legs during the session.

Simulator Sickness: Some participants experience simulator sickness while in the VR experience particularly after prolonged exposure. Simulator sickness symptoms can include fatigue, headache, eye strain, difficulty focusing, increased saliva in mouth, sweating, or nausea. This risk is moderate. We have 3 methods to reduce this risk. 1) Dosage of VR for this study is between 10-20 minutes which has been reported as typically used in the literature, so risk for motion sickness is reduced. 2) Participants will complete the Simulator Sickness Questionnaire after each experience to monitor for motion sickness. 3) Participants can halt any VR at any time for any reason.

Seizures: Some people may experience severe dizziness, seizures, eye or muscle twitching or blackouts triggered by light flashes or patterns during the VR. This risk is quite small. We have 2 ways to reduce this risk: 1) People with a known risk for seizures

will be excluded from this study. 2) If a subject experiences any of these symptoms we will immediately stop the VR. We will provide any indicated immediate supportive care, we will recommend that they see a doctor, and they will be discontinued from the study.

VR headset may be uncomfortable: Some people may find wearing the headset uncomfortable. This risk is small. We have 2 methods to reduce this risk: 1) we will work with the participant to adjust the headset to be as comfortable as possible. 2) participants can stop the VR experience at any time for any reason.

Contamination: The VR headset is tightfitting and in close contact with the skin of the face. It is possible that participants may cross contaminate contagious skin or eye disorders. This risk is small. We have 2 methods to reduce this risk: 1) We will exclude people who have active, contagious skin or eye infections. 2) We will use a washable face protector for each visit. Each device will be wiped with antibacterial cleaners after each use.

Exposure to trigger in a VR experience: VR experiences can seem very real, and a participant may be exposed to an item or situation (e.g. heights) that can trigger an adverse reaction. This risk is small. We have 2 methods to reduce this risk. 1) There will be a variety of VR meditation experiences that participants can choose from so participants can pick experiences that appeal to them and do not appear to have any triggers. 2) Participants can halt any VR experience at any time for any reason.

Risk of confidentiality:

Loss of confidentiality is another risk associated with this study, although this risk will be minimized by the use of a unique study number and password protected and encrypted databases. Data extracted for analysis will also be de-identified and personal identifiers will only be available to study staff.

EXPECTED BENEFITS

Participants have the potential to experience reduced pain symptoms during and after the VR experience. This result is very probable. Previous experiences suggest that the magnitude of this effect is, on average, large, and that the duration will be during the Virtual Reality experience and possibly up to a few hours or days afterwards.

EQUITABLE SELECTION OF SUBJECTS

The subjects recruited based on whether or not they meet the inclusion criteria above. These patients include people of all socioeconomic and ethnic categories, and no exclusions are made based on race, sex, or socioeconomic status.

RECRUITMENT PROCEDURES

We will recruit directly from the Pain Management Center through posted advertisements and ads on the waiting from TV. We will use the MGB Rally advertising platform to

provide interested subjects with information about the study, subjects can then provide their contact information.

Subjects will receive up to a total of $40 for participating in this study. Subjects will receive $30 for completing the Study Visit, and $10 for completing the final survey after the Visit. The payment will be in the form of an Amazon Gift card given at the end of the study. If subjects withdraw before completing the study visit, they will not receive payment.

CONSENT PROCEDURES

Informed consent will be obtained by either a study physician or a research assistant associated with the study. A physician will be available at all times to answer questions that a subject may have. The subjects are given ample time to consider their participation and if they are hesitant, are encouraged to take the consent form home and read it carefully before making their final decision. No subjects are enrolled who are unable to provide consent.

DATA AND SAFETY MONITORING

The principal investigator and the co-investigators will review data and safety monitoring on a weekly basis. The study will be terminated when the target enrollment is reached.

MONITORING AND QUALITY ASSURANCES

Study outcomes will be collected via REDCap database. The trained staff who carry out the procedures will also carefully monitor the study throughout its duration. The team will evaluate the progress of the study, verify that the rights and well-being of the subjects are protected, verify that the reported clinical study data are accurate, complete and verifiable from source documents, and the conduct of the study is in compliance with the approved protocol and amendments.

PRIVACY AND CONFIDENTIALITY

The identity of patients is not revealed to any outside sources. All patient identifiers will be kept in a separate secure file location, password protected on the MGB servers. Only certified and trained study staff will have access to the information.

During the 14-week study period, all study records will be stored in a locked file drawer accessible only to study personnel in the Brigham and Women's Pain Management Center Research Lab. Electronic records will be collected using REDCap and stored in a password protected files. No electronic addresses will be attached to material. After the 14-week study period all de-identified data will be shared with Tufts University, data will be retained

at Tufts in 574 Boston Ave or other secure storage used by the department for a period of 7 years.