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Challenges and Practical Considerations in Applying Virtual Reality among Tamil Geriatric Patients with Periarthritis Shoulder – A Qualitative Study

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Abstract

Background: Virtual Reality (VR) has shown promise in healthcare, especially in areas like cognitive training, pain management, and motor rehabilitation, yet adapting it for use among elderly individuals comes with specific limitations and barriers. **Aims and Objectives**: This study analyses the challenges and practical considerations in applying Virtual Reality (VR) to Tamil geriatric patients during physiotherapy management. **Materials and Methods:** This qualitative study, utilized in-depth interactive interviews through a Semi-structured interview to collect and analyse data. Participants 34 native Tamil geriatric patients aged more than 60 years (67.5 ±2.78) complaining of a painful restricted range of motion in the unilateral shoulder joint diagnosed as periarthritis shoulder were treated with fully immersive virtual reality technology for 7 days. Following the intervention, the patients were interviewed under 5 codes ("usability," "comfort," "satisfaction," "technical issues," and "practical consideration") **Results:** Participants reported virtual reality was enjoyable and engaging, a positive impact and motivation. Dizziness and sweating during virtual reality sessions when it extended beyond 20 minutes was a concern. Several participants faced hardware problems, such as issues with headset fit, leading to discomfort and difficulties in using hand-held control buttons. Adjusting virtual reality settings, including boundaries and game-level setting, was mentioned as a practical challenge for some participants. **Conclusion:** Proper orientation, patient selection for virtual reality, and sufficient familiarization are essential for the success of virtual reality rehabilitation among the Tamil geriatric population

Keywords: Health Risk, Immersive Technology, Motor Retraining, Periarthritis Shoulder, Pain Perception, Technology-Based Intervention, Virtual Reality

1. Introduction

Virtual reality is another means to provide virtual reality due to its ability to design a standard, reproducible, and controllable environment, has been increasingly used in rehabilitation for functional re-education. There is a constant search for advancement in every health field, and physiotherapy is no exception. Virtual Reality can be the best answer for this as it is one unique advanced tool where the patient is actively participating. The effects of virtual reality for Periarthritis Shoulder (PAS) have already been proved with better improvement in pain-free active range of motion and upper limb function[1,2]. However, there are many practical obstacles in administering the technology-based intervention that need to be analyzed[3]. While

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virtual reality has shown promise in healthcare, especially in areas like cognitive training, pain management, and motor rehabilitation, adapting it for use among elderly individuals comes with specific limitations and barriers[4].

Virtual reality is a type of computer-assisted instruction where users can interact with a constructed environment and receive prompt responses to tasks[5]. It operates on the tenet of strengthening muscles while improving skills, which include the quantity, quality, and direction of the activity, as well as keeping the patient, focused on their task[6]. It also modifies the patient's requirements and the degree of difficulty in order to achieve the goal. It proved to be beneficial in the patient suffering from periarthritis shoulder[7]. The user with real-time visual feedback of their performance. It has been used extensively for upper limb rehabilitation, e.g., using the kinect sensor[8]. Different virtual reality systems have been shown to be effective in survivors of stroke[9], as well as in individuals with kinesophobia and fragility in shoulder periarthritis[10]. To the best of our knowledge, it has yet to be applied for individuals with stiff shoulder. However, recently, a system that combines virtual reality with wearable inertial measurement unit sensors was designed to perform motor assessment of shoulder range of motion for this population[11]. The system was later utilized as a self-measurement system for shoulder joint mobility during four shoulder joint movements[12]. These systems have been used to provide non-manipulated real-time biofeedback.

2. Materials and Methods

This descriptive qualitative study was conducted at two private clinics in Chennai. The study was cleared of ethical concerns by the institutional ethical committee at Madhav university, Sirohi, Rajasthan, and every patient signed an informed consent (IEC/MU/2022/AHS/21). This qualitative study utilized in-depth interactive interviews through a semi-structured interview to collect and analyze data. Participants 34 native Tamil geriatric patients aged more than 60 years (67.5 ± 2.78) complaining of a painful restricted range of motion in the unilateral shoulder joint diagnosed as periarthritis shoulder. Both genders are included in this study. Age more than 60 years, Patients suffering from PAS for at least one-month duration, and patients who are fluent in Tamil. Patients who had good comprehensive skills. Subjects who had a restricted active range of motion of at least 20 degrees in shoulder elevation (abduction, flexion, and scaption) and/or rotation. Patients who had undergone previous physiotherapy sessions for PAS without virtual reality are included in this study. Patients who had vestibular problems, visual perceptual disorders, tremors, history of frequent falls, and poor balance and proprioception are excluded in this study.

3. Procedure

This qualitative study was performed using immersive virtual reality technology through an oculus headset (Meta version 2). The subjects were oriented regarding virtual reality technology and its advantages, usability, and user interface instructions like setting the boundaries, selecting the game, setting the level, and usage of hand-held control buttons. After two days of (30-minute session) demonstration and trial run, they were subjected to actual intervention protocol for seven days (20-30 min) with a tailor-made intervention. The protocol comprised of "Beat saber", in which the patients were provided with a blue sword and red sword for the right and left hand respectively. The patients were given the task of cutting the objects approaching them using both hands in different directions with a free swing of the arm. Blue-colored objects have to be cut be a blue sword and red objects with the red sword in the direction indicated with an arrow mark in the approaching object. The speed and intensity of the game were altered based on patients' comfort. After the patients participated in the intervention they were interviewed "one on one" by an interviewer who was actively engaged in conversation. Only one patient was interviewed on one day and they were interviewed immediately after day seven intervention. The patients were treated for three treatment sessions on alternate days for two weeks and one additional session (7^{th}) on the third week when they were interviewed. There was a questionnaire designed for this study by a four-member panel (senior physiotherapists who had at least two years of experience in using virtual reality and more than ten years of clinical experience).

3.1 Outcome Measures

Following the intervention, the patients were interviewed, and individual transcripts were documented. There were 5 codes under which questions were asked

"usability", "comfort", "satisfaction", "technical issues", and "practical consideration". Codes "usability", "comfort", and "satisfaction" were grouped under the theme "user experience". Codes like "technical issues" and "practical considerations" are grouped under the theme "technical challenges".

4. Results

Based on outcome measures themed around user experience, the results indicate that several factors impact usability. Reduced fine motor skills, hand-eye coordination, and age-related vision changes, such as diminished acuity or depth perception, make learning to use Virtual Reality (VR) systems more challenging. Comfort results highlight headset weight, strap design, and glasses compatibility issues. Additionally, patients reported heat-related issues, sweating, and motion sickness while using VR systems. In terms of satisfaction, the results show that 54% of patients were engaged while using VR, 42% enjoyed the experience, 44% were highly motivated to use VR, and 38% showed improved compliance. Some patients found conventional exercises to be safe and satisfying. However, the virtual ambiance and the therapist's auditory stimuli were sometimes confusing for patients using VR. Regarding technical challenges, there were no specific issues reported aside from boundary fixing and hardware concerns like headset fit and hand controller usability. Practical considerations revealed that the complex user interfaces and limited content variety (mostly gaming) were problematic. Affordability of VR systems was also checked. Some elderly patients felt that even the easiest game levels were too difficult due to these practical issues.

5. Discussion

This study employed the interview method which is rarely used in the field of physiotherapy[13]. Participants reported virtual reality was enjoyable and engaging and felt a positive impact and motivation. Comfort was an issue for some participants, with reports of dizziness and sweating during virtual reality sessions when it extended beyond twenty minutes. Consistent with previous studies the eases of use and user-friendliness of the virtual reality technology influenced overall satisfaction. Several participants faced hardware problems, such as issues with headset fit, leading to discomfort and difficulties in using hand-held control buttons. Software glitches were reported by a few participants, causing interruptions in their virtual reality sessions. Adjusting virtual reality settings, including boundaries and game-level settings, was mentioned as a practical challenge for some participants. Despite these complaints, it's understood that the geriatric population has complained even with conventional exercises and other types of virtual reality technology as well. Tamil aged was selected to bring about homogeneity in the aged population. We initially perceived that technical issues might be concerns but later understood that individual variations, experience, and knowledge with computer gadgets, and wearable devices and subjective feelings were major concerns for implementing virtual reality-based rehabilitation. The treatment plan was initiated with the use of virtual reality computer-assisted learning, which allows people to interact with one another through the creation of an environment that facilitates quick work completion[6]. It has demonstrated the patient's outstanding performance by giving them more self-assurance to work out without worrying about their pain.

Hand function gets affected following shoulder injuries which can affect the hand eye coordination as well[14]. Virtual reality technology when attesting to the shoulder will also influence hand-eye coordination and hence offer holistic treatment for shoulder problems. The study, while addressing a pertinent practical issue, possesses certain limitations that warrant consideration. Notably, it did not employ quantitative methods to establish the objectivity of its findings. This omission may be justifiable given the abstract nature of the variable under investigation, which does not lend itself easily to quantification. Consequently, the generalizability of the study's results is restricted, as it was conducted exclusively on patients with periarthritis shoulder[15]. Acknowledging these limitations, it's important to highlight the strengths of the study that offset these constraints. The research addresses a significant and ongoing challenge encountered by physiotherapists, particularly in diverse populations like that of India. While the ideal scenario would involve the widespread implementation of technology in healthcare, numerous obstacles impede this process, necessitating thorough consideration for the delivery of seamless therapy and optimal user experiences[16]. By focusing on elucidating these obstacles, the study serves as a foundational step for future quantitative research endeavours and avoid

health risks to patients undergoing virtual reality-based rehabilitation. It lays the groundwork for further exploration into this multifaceted issue, offering a starting point for subsequent investigations aimed at enhancing the efficacy and accessibility of physiotherapy interventions in diverse healthcare settings[17].

6. Conclusion

Though virtual reality is an emerging technology and an effective intervention tool there are some challenges in applying it to the Tamil geriatric population. Proper orientation, patient selection for virtual reality, and sufficient familiarization are essential for the success of virtual reality rehabilitation. From the current study we also understand a patient-centered intervention model is needed in implementing virtual reality as some geriatric patients may not prefer virtual reality -based exercises and will show apprehension to treatment. We also feel advancement in headset quality and user interface can minimally solve geriatric patients' usability as the obstacles were predominantly individualized experiences.

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