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Original Research Article

A CLINICAL TRIAL OF VIRTUAL REALITY IN PHYSICAL THERAPY FOR BURN PATIENTS: EFFECTS ON PAIN PERCEPTION

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Abstract *In clinical contexts, virtual reality (VR) has demonstrated potential as a cognitive diversion technique to alleviate discomfort among patients undergoing challenging procedures, including physical rehabilitation for burn victims. However, the extent of research investigating the effectiveness of VR in reducing pain during physical therapy for burn patients is limited. This clinical trial was conducted at Civil Hospital's burns unit in Hyderabad and involved 68 participants. Each participant underwent two 6-minute physical therapy sessions, one utilizing VR and the other without VR. After each session, participants provided feedback on their pain experience, which the treating therapist documented. Analysis of graphic rating scores revealed a significant decrease in pain levels during physical therapy with VR compared to physical therapy without VR. The average scores for pain rumination, worst pain intensity, and unpleasantness decreased from 5.99 to 3.88, 6.24 to 3.41, and 6.18 to 3.82, respectively. The paired t-test indicated a highly significant p-value of less than 0.001. The results of this study suggest that VR is a valuable tool for reducing pain during physical therapy for burn patients. Further research is necessary to explore the long-term effects of VR on pain management and its potential application in other clinical settings*.

Keywords: Virtual Reality; Burn; Physical Therapy; Trauma; Pain

Introduction

Burn injuries result in significant pain, anxiety, and trauma, which have psychological and physiological consequences (Yuxiang et al., 2012; Das et al., 2005). Effective pain management is essential for timely healing and successful rehabilitation of burn patients Sharar et al., 2008). However, pain experienced by burn patients can be challenging to control with traditional pain medications due to its various manifestations, such as constant background pain, pain during movements, and pain during physical therapy Connor-Ballard, 2009). Physical therapy has been proven effective in enhancing the range of motion, reducing permanent impairments, and promoting endurance and mobility for burn patients (Schmitt etal., 2011; Carrougher et al., 2009; Hussain et al., 2017. Nevertheless, managing pain during rehabilitation poses difficulties, and current treatments like anxiolytics and opioids often come with significant side effects (Hoffman et al., 2011; Manni et al., 2011).

Distraction techniques, including deep breathing, music, hypnosis, and biofeedback, have been used alongside painful medical procedures to reduce pain perception and alter the pain experience for patients (Patterson et al., 2010; Wiederhold et al., 2014). Among these techniques, distraction effectively reduces pain intensity during medical procedures (Eccleston and Crombez, 1999; Hoffman, 2004; Crawley, 2004). Recently, immersive virtual reality (VR) technology has emerged as a promising non-

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pharmacological intervention for post-burn physical therapy by providing cognitive diversion and creating an artificial environment that can alleviate pain intensity, anxiety, and unpleasantness during wound care procedures and physical therapy (Lambert et al., 2013; Hussein, 2015; Abdelmoniem and Mahmoud, 2016; Dahlquist et al., 2010). By diverting patients' attention from their surroundings, VR technology can reduce the time patients spend ruminating on pain, leading to decreased focus on unpleasant stimuli and a more positive and enjoyable experience during physical therapy (Crawley, 2004; Lambert et al., 2013). Passive distraction, where patients passively observe the distracting stimulus, has proven effective in reducing pain during medical procedures (Abdelmoniem and Mahmoud, 2016; Dahlquist et al., 2010). This study aims to investigate using passive distraction through immersive VR technology to modulate procedural pain in the burn population. By reducing pain intensity and enhancing patient engagement, VR can provide a more positive and enjoyable physical therapy experience for burn victims (Krout, 2001; Bellieni et al., 2006). The current study seeks to explore passive distraction through immersive VR technology in the burn population to modulate procedural pain, aiming to improve rehabilitation outcomes and overall quality of life for burn injury patients.

Materials and methods

A six-month clinical trial was conducted at the Burns unit of Civil Hospital Hyderabad, Pakistan. Simple random sampling was utilized to recruit 68 eligible in-patients from an estimated sample size 90. The study focused on acute burn victims who required physical therapy within the first 10 days of their hospital stay. Inclusion and exclusion criteria were clearly defined, with subjects required to be at least 8 years old and have a burn injury covering 18% of their Total Body Surface Area (TBSA), regardless of the cause (electrical, chemical, thermal, scald, etc.). Excluded from the study were patients who had undergone surgery within the last 5 days, individuals with severe burns on the scalp and ear that would impede the use of VR equipment, patients under the age of 8, and those with a history of seizures.

Data collection procedure

After obtaining informed consent from eligible participants, each participant was randomly assigned to receive virtual reality (VR) either 1st or 2nd . The treatment order was randomized to ensure an equal chance of receiving VR 1st, No VR 2nd, or No VR 1st and Yes VR 2nd. Patients received 12 minutes of physical therapy divided into two 6-minute segments, during which the physical therapist performed Active Assisted Range of motion and Passive Range of Motion exercises on affected joints. In the VR segment, patients were instructed to wear VR gear and headphones, focusing on high-definition natural scenes accompanied by music while the therapist performed the exercises. The therapist followed the same exercise protocol without VR in the no-VR segment. After each 6-minute session, there was a short break. Each individual provided three subjective pain ratings using a Graphic Rating Scale ranging from 0 to 10, reflecting their pain experience during the preceding 6 minutes of physical therapy. The patients' medication regimens were independent of the study protocol.

Results

In this study, 90 burn patients were initially approached for the study; out of them sixty-eight fulfilled the eligibility criteria and participated in the study. The remaining 22 individuals were excluded for various reasons, including 10 who declined to participate, 5 with severe burn injuries, and 7 with recent surgical grafts. Among the 68 participants, there were 37 males and 31 females, with an average age of 29.19. The participants' mean total burn surface area (TBSA) was 20.59%.

During the physical therapy the thinking about pain and time spent on it without virtual reality, four respondents reported that they didn't think about pain during their time spent; thinking about pain for some time was responded by six persons, half of the time was responded by twenty-six, most of the time was responded by twenty-seven. Five of them responded for the whole duration. Comparatively, the mean score of 3.41 for respondents who experienced virtual reality was significantly lower than that of 6.24 for those without virtual reality, indicating that virtual reality substantially reduces the impact of worst pain among burn injury patients ($p<0.001$).

Table 1: Shows the distribution of participants based on the percentage of total burn surface area (TBSA). The majority of participants (50.0%) had a TBSA ranging from 16% to 27%, followed by 29.4% with TBSA between 3% and 15%, 11.8% with TBSA between 28% and 39%, 5.9% with TBSA between 40% and 51%, and 2.9% with TBSA of 52% and above.

Table 1: **Total burn surface area n=68**

Burn surface area	Frequency	Percentages
3% to 15%	20	29.4
16% to 27%	34	50.0
28% to 39%	8	11.8
40% to 51%	4	5.9
52% and above	2	2.9
Total	68	100.0

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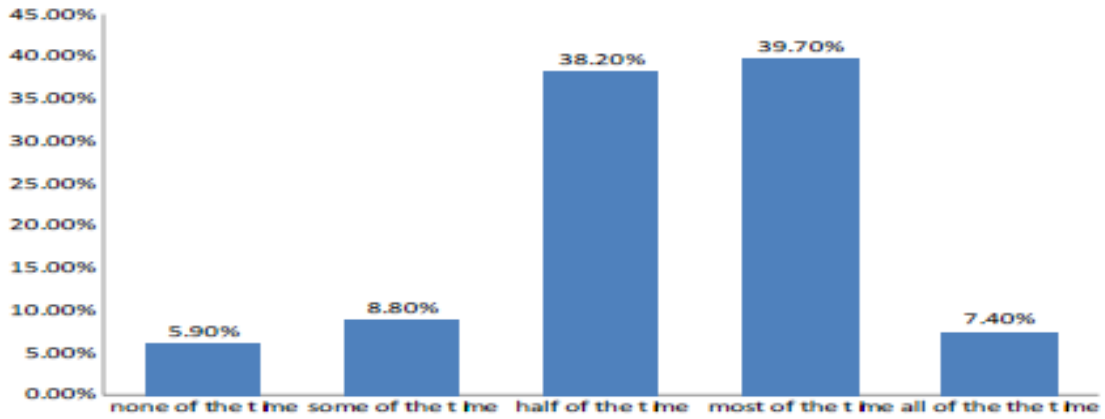

Figure 1 depicts the percentages of time spent thinking about pain during the past 6 minutes without virtual reality.

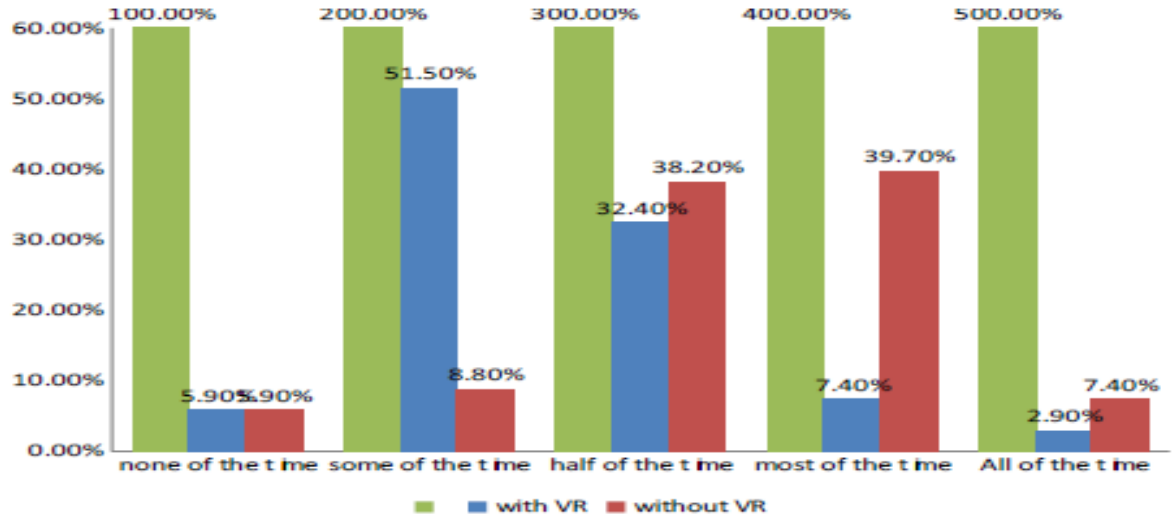

Figure 2: show the combined bar graphs for the percentages of time spent thinking about pain and the worst pain felt with and without virtual reality, respectively

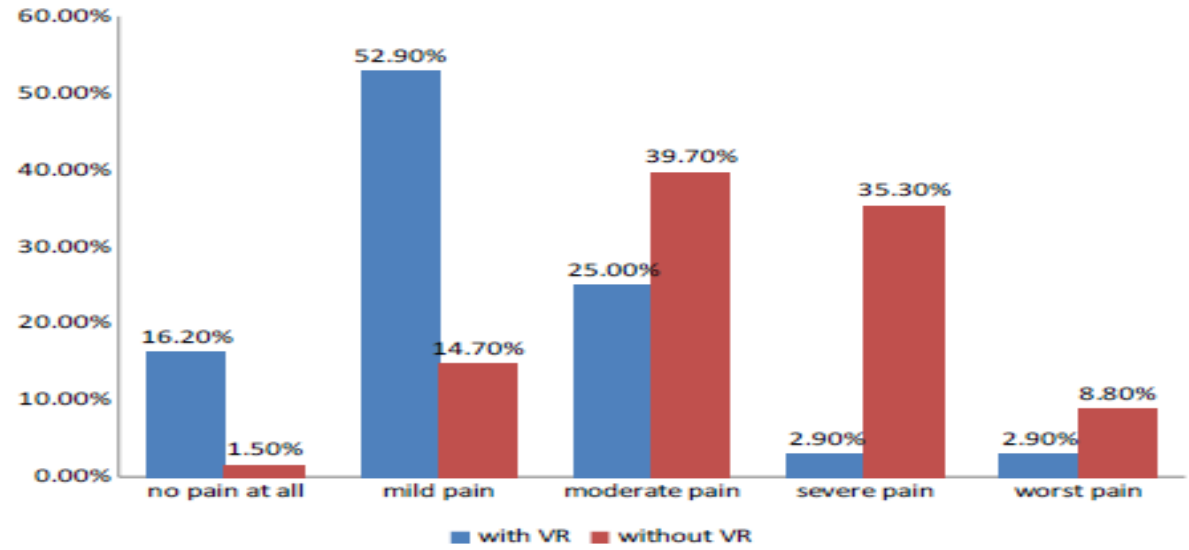

Figure 3: show the combined bar graphs for the percentages of time spent thinking about pain and the worst pain felt with and without virtual reality, respectively

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Discussion

Physical therapy is crucial in treating burn injuries, even when pharmacological interventions are employed. Throughout the recovery process, burn patients undergo various procedures that can result in severe pain. VR (Virtual Reality) is a novel form of cognitive distraction that can be utilized to manage pain. The findings of this study align with previous research, such as the study conducted by Bellieni et al. (2006), which demonstrated that passive distraction, such as watching TV, was better in alleviating pain than the method through active distraction, where moms actively distracted their children during venipuncture through soothing, caressing and speaking. The results from this study also support the findings of Krout (2000), who reported that music therapy, another form of passive distraction, significantly reduced both observed and self-reported pain. Furthermore, the results of the present study are consistent with Carrougher et al.'s research (Manni et al., 2011), which investigated the impact of VR on pain in adults (burn injuries) and it was observed that VR reduced the severity of worse pain and pain unpleasantness. The Time spent "thinking about pain" by twenty-seven, thirty-one, and thirty-seven percentage, respectively, in comparison without VR. However, the present study differs from earlier research conducted by Schmitt et al. (2011), and Law et al. (2010), as the VR setup used in those studies was more advanced than the simple VR Gear employed in this study due to resource limitations. Additionally, this study sheds light on how pain impedes the daily activities of burn patients, emphasizing the importance of addressing this issue. However, the study has several limitations that warrant consideration, including the short duration of the study, the predominantly illiterate subjects who faced challenges in communicating their condition, and the need for a more advanced VR system and software to provide enhanced distraction.

Conclusion

Utilizing virtual reality (VR) as an additional analgesic method is a valuable and efficient approach for burn patients. This pioneering study in Pakistan highlights VR's effectiveness as a non-pharmacological intervention, demonstrating its potential to enhance patient engagement and compliance during rehabilitation sessions. The issue of acute pain during medical procedures extends beyond burn patients, warranting further investigation in this area.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Funding

Not applicable

Conflict of Interest

Regarding conflicts of interest, the authors state that their research was carried out independently without any affiliations or financial ties that could raise concerns about biases.

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