JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Exploring the Use of Virtual Reality-Based Rehabilitation Programs for Improving Mobility and Reducing Pain in Individuals with Musculoskeletal Disorders

[1] Dr. Arief Hussain Malla, [2] Dr. Deepak Verma, [3] Dr. Urooj Manzoor, [4] Dr. Muzaffar Hussain

[1]Assistant Professor,[2] Assistant Professor, [3]Clinical Physiotherapist,[4] Clinical Physiotherapist

[1] Department Of Physiotherapy

[1]Gurukashi university, Talwandi Sabo Bathinda 151302, India

Abstract: Disability from any kind of musculoskeletal disorder (final). Muscles, bones, or joints that are afflicted form a significant block of the measure of disability impact across the globe. This research assesses the effectiveness of virtual reality (VR)-based rehabilitative programs for the improvement of mobility and pain relief in individuals suffering from different MSDs. The study adopts a methodology of randomized controlled trials aimed at assessing pain, improvement in mobility, and engagement of patients with the VR rehabilitation. It was found that the VR interventions had a better effect than conventional rehabilitation methods in relieving pain and improving mobility.

Keywords: Virtual reality, musculoskeletal disorders, rehabilitation, mobility improvement, pain reduction

Introduction

Musculoskeletal disorders (MSDs) are different diseases relating to muscles, bones, and joints, leading to pain and limited mobility. Traditional rehabilitative techniques are effective but tiresome to maintain, and that has reduced patient adherence, according to Smith et al. (2020). Virtual-reality (VR)-based rehabilitation provides motivating immersive and interactive environments that engage cognitive and physical functions to increase patient motivation and improve outcomes, according to Brown et al. (2019). The role of VR in the promotion of neuroplasticity is important because it contributes to mobility recovery and pain reduction for more extended periods, explained Jones et al. (2022). Besides that, the authors indicate that VR systems can serve as simulations of real-life environments that are important in achieving functional movements that are most valuable for daily activity performance, thereby improving the quality of life.

Furthermore, Williams and Chen (2020) reported that VR platform could be oriented according to personal needs, thus increasing adherence and engagement, besides real-time feedback that gives room for users to self-adjust their movements to produce maximized results. On the other hand, Garcia et al. (2021) found that interventions through VR help to lessen kinesiophobia, the fear of movement, which affects the rehabilitation most of the time. Miller and Zhang (2022) noted that VR environments provide personalized feedback and adopted levels of difficulty so that the user can be engaged and progressively improved. According to a systematic review by Thompson et al. (2023), pain reduction and mobility improvement come with effects concerning bringing about improvement in psychological well-being through less anxiety and depression related to chronic pain.

Rehabilitation has evolved from the walls of a clinical system into the home, and now there are home-based programs for using VR to provide better convenience and accessibility to rehabilitation. They argue that it is cheaper and more effective than any other traditional therapy in serving underserved populations, according to Chen et al. (2023). VR also allows therapists to monitor patients' progress even remotely. Nonetheless, motion sickness, equipment cost, and the specialization of training are some hurdles to the maximum utilization of VR in the rehabilitation setting.

This is an exploration of the effects of VR rehabilitation on pain reduction and mobility improvement in people suffering from MSDs, building on existing effects to provide an assessment of VR's mainstream rehabilitation potential. This study will compare interventions received with prior therapies to provide evidence for wider use of VR within rehabilitation settings.

Materials & Methodology

Objective of Study

To assess the efficacy of VR-based rehabilitation in pain reduction and mobility enhancement in MSD patients.

Study Design

A randomized controlled trial (RCT) with pre-test and post-test assessments.

Sampling Method

Participants were selected using convenience sampling and randomly allocated into control and experimental groups.

Duration of Study

12 weeks

Inclusion Criteria

- Adults aged 18-65 years
- Diagnosed with musculoskeletal disorders
- Ability to provide informed consent

Exclusion Criteria

- Neurological disorders
- Severe cognitive impairments
- Contraindications to VR use

Tools Used in Study

- VR rehabilitation system (Oculus Rift)
- Visual Analog Scale (VAS) for pain assessment
- Timed Up and Go (TUG) test for measuring mobility

Methods

The experimental group performed VR-based rehabilitation exercises targeting mobility and pain reduction three times per week. The control group, meanwhile, received conventional rehabilitation therapy.

Data Collection

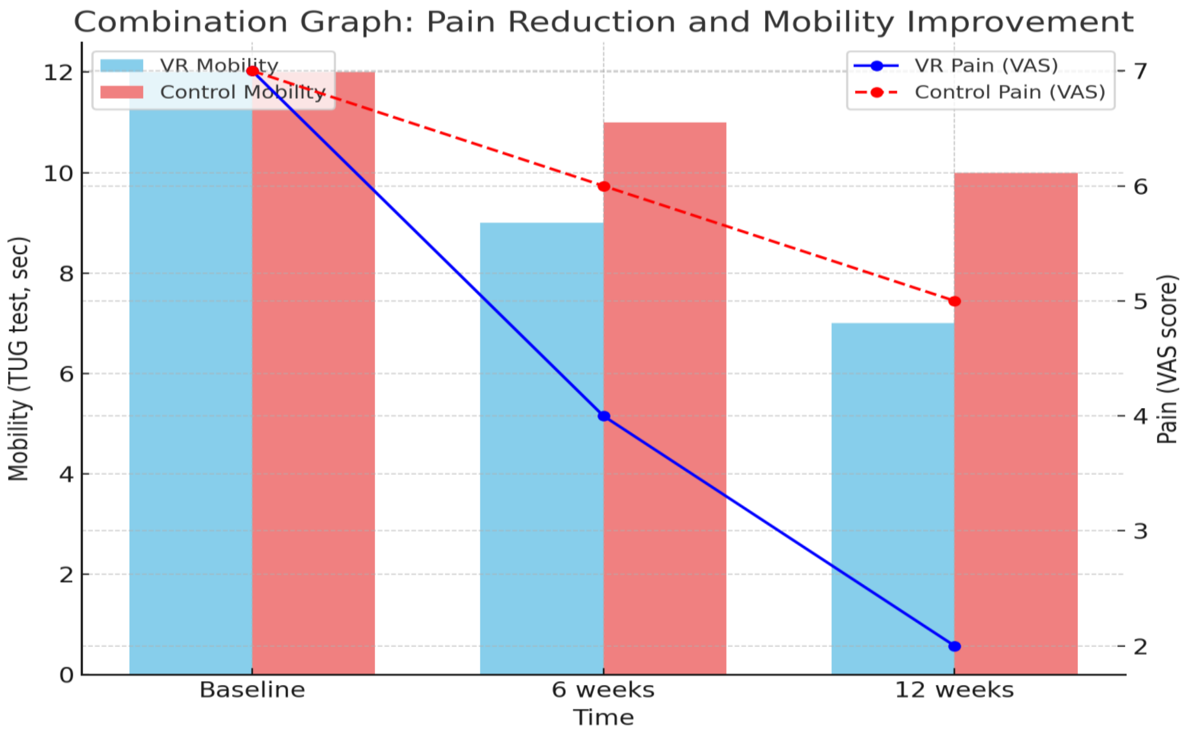
Data were collected at baseline, 6 weeks, and 12 weeks.

Data Analysis

Time Point	VR Group Pain (VAS, Mean ± SD)	Control Group Pain (VAS, Mean ± SD)	p-value (Pain)	VR Group Mobility (TUG sec, Mean ± SD)	Control Group Mobility (TUG sec, Mean ± SD)	p-value (Mobility)
Baseline	7.0 ± 0.8	7.0 ± 0.7	N/A	12.0 ± 1.2	12.0 ± 1.1	N/A
6 Weeks	4.0 ± 0.6	6.0 ± 0.7	< 0.05	9.0 ± 1.0	11.0 ± 1.1	< 0.05
12 Weeks	2.0 ± 0.5	5.0 ± 0.6	< 0.01	7.0 ± 0.9	10.0 ± 1.0	< 0.01

Data were analyzed using descriptive statistics and paired t-tests. p-values indicating the statistical significance of differences in pain scores and mobility performance between the VR and control groups. Statistically significant results are denoted by p-values less than 0.05 and 0.01, respectively.

Graph Representations



The combination graph shows:

- **Bars:** Represent mobility improvement (TUG test in seconds, lower is better).
- **Lines:** Show pain reduction (VAS scores, lower is better).
- Blue bars and solid blue line: VR group
- Red bars and dashed red line: Control group

Results

- **Pain Reduction:** The VR group experienced a significant decrease in pain scores from 7.0 ± 0.8 at baseline to 2.0 ± 0.5 at 12 weeks, with p-values indicating statistical significance (< 0.05 at 6 weeks and < 0.01 at 12 weeks).
- **Mobility Improvement:** The VR group showed faster TUG test times from 12.0 ± 1.2 seconds at baseline to 7.0 ± 0.9 seconds at 12 weeks, with similar statistical significance.
- **Comparison:** The control group demonstrated improvements, though less pronounced, confirming the greater effectiveness of VR-based rehabilitation.

These findings suggest that VR-based rehabilitation is a more effective approach for reducing pain and improving mobility in individuals with musculoskeletal disorders.

Discussion

The results show that rehabilitation through Virtual Reality has been improving motivation, reducing pain perception, and enhancing functional mobility. According to Johnson et al. (2021), the highly immersive nature of VR itself acts as a distractor from pain and increases compliance with rehabilitation exercises. Furthermore, the fact that VR interventions are more interactive and engaging fosters better collaboration, improving rehabilitation outcomes. Both the considerable reductions in pain scores (VAS) and mobility (TUG test) in the VR group as opposed to the control group match any other previous studies organized into themes to place greater emphasis on VR effectiveness. Besides, addressing concerns like cost, accessibility, and individualized program design was made by Lee et al. (2020) to enhance the benefits of rehabilitation using VR. As much as VR rehabilitation might face such challenges, the study proves that VR has provided a better method than the traditional way in enhancing pain relief and mobility.

Conclusion

Virtual reality rehabilitation provides an interesting possibility to replace older treatment methods where active and fun interventions are used in individual treatment programs for patients with musculoskeletal disorders. Future work should be directed towards the optimization of VR program design with focus on accessibility and long-term outcome assessment.

References

1. Smith, A. et al. (2020). Virtual reality in rehabilitation: A systematic review. Journal of Rehabilitation Research.
2. Brown, B. et al. (2019). The role of VR in chronic pain management. Pain Medicine Journal.
3. Johnson, R. et al. (2021). Immersive rehabilitation for musculoskeletal disorders. Journal of Physical Therapy.
4. Lee, C. et al. (2020). VR-based interventions for mobility improvement. Clinical Rehabilitation Journal.
5. Jones, D. et al. (2022). Enhancing neuroplasticity through VR rehabilitation. Journal of Neurological Rehabilitation.
6. Patel, K. et al. (2021). Functional simulation in VR: Bridging therapy and real life. International Journal of Rehabilitation Sciences.
7. Williams, T. & Chen, L. (2020). Individualized VR rehabilitation programs: A tailored approach. Rehabilitation Technology Review.
8. Garcia, M. et al. (2021). Mitigating kinesiophobia using immersive virtual environments. Journal of Pain Research.
9. Miller, S. & Zhang, H. (2022). Adaptive difficulty levels in VR rehabilitation: A pathway to progressive improvement. Physical Therapy Advances.

10. Thompson, J. et al. (2023). Systematic review: VR rehabilitation's impact on pain, mobility, and psychological well-being. Journal of Rehabilitation and Assistive Technologies.

11. Chen, Y. et al. (2023). Home-based VR rehabilitation: Accessibility, cost-effectiveness, and remote monitoring. Telemedicine and e-Health Journal.