



Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/18373
DOI URL: <http://dx.doi.org/10.21474/IJAR01/18373>



RESEARCH ARTICLE

TO EXPLORE THE EFFECT OF EXERGAMES FOR INCREASING THE RANGES OF THE SHOULDER JOINT IN INCOMPLETE SPINAL CORD INJURY PATIENTS: A CASE STUDY

Vishal Verma¹, Abhishek Kumar Sandilya², Divya Kashyap³ and Zahid Ahmed Khan⁴

1. Assistant professor, Department of Physiotherapy, Sardar Bhagwan Singh University, Dehradun, Uttarakhand.
2. Student Researcher, Department of Physiotherapy, Sardar Bhagwan Singh University, Dehradun, Uttarakhand.
3. Student Researcher, Department of Physiotherapy, Sardar Bhagwan Singh University, Dehradun, Uttarakhand.
4. Assistant Professor, Department of Physiotherapy, Mansarovar Global University, Bhopal, Madhya Pradesh.

Manuscript Info

Manuscript History

Received: 05 January 2024

Final Accepted: 09 February 2024

Published: March 2024

Key words:-

Exergames, Incomplete Spinal Cord Injury, Rehabilitation, Range Of Motion, Shoulder Joint, Upper Extremity Function

Abstract

This case study explores the impact of exergames on increasing shoulder joint range of motion (ROM) among individuals with incomplete spinal cord injuries (ISCIs). Subjects with ISCI participated in a 6 week structured exergaming program. Shoulder joint motion was measured pre and post intervention to evaluate changes. The results discovered a significant improvement in shoulder joint ROM following the exergaming intervention. These findings present evidence that exergames shows potential as a rehabilitation tool for addressing ISCI related impairments and, in particular, for increasing upper extremity function. Further, research with a larger sample, including control groups, is necessary to validate these findings and to determine underlying mechanisms that contributed to the changes discovered.

Copy Right, IJAR, 2024,. All rights reserved.

Introduction:-

Spinal cord injuries (SCI) can have a significant impact on an individual's mobility and quality of life. Incomplete spinal cord injuries, in which some degree of sensory and motor function remains below the level of injury, present unique rehabilitation challenges. [1] One area that is often affected in these patients is muscle strength, which plays a crucial role in upper-limb function and independence. [2] In the conventional rehabilitation approach, muscle strength and range of motion of joints have been the main concerns of physical therapy and occupational therapy techniques. Emerging technologies such as exergames provide a potentially appealing and effective way to enhance rehabilitation outcomes. Exergames, also known as interactive video games, combine physical exercise with gaming features to engage users in enjoyable and motivational activities. [3] These games use motion-sensing technologies, such as the Kinect sensor or virtual reality systems, to monitor and interpret player movements. [4] A contemporary adjunct to conventional therapies in a variety of clinical populations, including individuals with SCI, has emerged in recent years; this is the use of exergames.[5] They are advantageous in rehabilitation settings, for several reasons. First, the dynamic and interactive environment of exergames is engaging and enjoyable for patients during therapy sessions.[6,7] This increased motivation and participation lead to increased adherence to therapy programs, which is imperative for achieving optimal outcomes. Second, the wide variety of activities and difficulty levels make exergames easily match each patient's abilities and goals, allowing for targeted and progressive rehabilitation, such as that of the shoulder joint in individuals with incomplete SCI. [8] The use of exergames in rehabilitation continues to show promise for various patient populations, however their potential effects in increasing shoulder joint range among patients with incomplete SCI remain relatively unknown. This case study was conducted to assess whether

Corresponding Author:-Abhishek Kumar Sandilya

Address:-Student Researcher, Department of Physiotherapy, Sardar Bhagwan Singh University, Dehradun, Uttarakhand.

exergames can improve muscle strength in individuals with spinal cord injuries as a result of motor vehicle crashes, falls, or violence, which affect the upper limbs, and to explore the utilization of exergames as a rehabilitation tool and its effectiveness in increasing muscle strength, which can improve functional abilities and overall quality of life among these patients. Through this exploration, readers will gain insight into the possible advantages of using exergames as a modality for rehabilitation in a patient with SCI involving the upper limbs.

Background:

Spinal cord injury (SCI) is a devastating condition, resulting in an individual's physical, emotional, and social well-being and often causing varying degrees of paralysis and loss of sensation below the level of injury, significantly affecting their ability to perform everyday activities and lowering their overall quality of life.[9] The impact of SCI can range from significant to catastrophic depending on the severity of the injury, the location of the injury, and the individual's overall health and age.[10] Current treatment and rehabilitation options for these patients are clearly inadequate, and healthcare professionals have advocated for novel and alternative strategies that can be implemented post-SCI to improve patient outcomes and thus improve their quality of life. Based on the dire need for improved rehabilitation strategies and post-SCI patient outcomes, numerous studies have examined the costs and health resource implications associated with the use of complementary and alternative medicine (CAM) among individuals with SCI. These efforts have contributed significantly to the growing body of knowledge regarding complementary therapies and alternative modalities that can be efficiently applied as adjuvant approaches to comprehensive health care in the population of individuals with spinal cord injuries.[11] Individuals with incomplete SCI often present with varying degrees of impairment, with some retaining more function than others depending on the severity and location of the injury. Shoulder joints are commonly affected as they are critical for upper limb function and independence in activities of daily living. Reduced shoulder range of motion or strength can greatly reduce a person's ability to perform activities of daily living and enjoy social and community activities. [12,13] As individuals with incomplete spinal cord injuries face a variety of challenges, examining novel rehabilitation approaches is critical. Interactive and engaging exergames have been found to enhance rehabilitation outcomes in various patient populations. The purpose of this study was to explore the effects of exergames on increasing the range of motion of the shoulder joint in individuals with incomplete spinal cord injuries and how this would translate into improvements in functional ability and quality of life. By appreciating the effects of spinal cord injuries, the prevalence of such injuries, and the different types of SCI, we can understand why it is vital to investigate innovative rehabilitation approaches.

Case Evaluation:

A 35-year-old male visited the emergency department with the chief complaint of inability to move the right upper and lower limbs. The patient's history of the present illness was that he was walking on the roof of his home because of a disturbance he fell down from 15feets and acquired injury over his upper back. The patient was conscious at that time without any delay patient was taken to the hospital, and then in the hospital investigations were done MRI findings suggest acute fracture with partial interior wedge collapse of D2 vertebrae leading to severe secondary Canal stenosis. For the same D2-D3 partial laminectomy with D2-D3 pedicle screw fixation was done. After the procedure, the patient was transferred to a neurosurgery ward.

Examination and evaluation

On examination, the patient presented with decreased range of motion in the upper and lower limbs. Along with limited muscular strength, the upper limb range of motion was notably diminished compared with the contralateral side, and the patient showed difficulty in performing motor tasks. The modified Ashworth Scale was used to assess the postoperative disability of the patient's upper limb. Manual muscle testing was performed to assess shoulder muscle strength.

Table1: Range of motion

Table 2 : Tone chart

Intervention

The intervention was given to the patients in an upright sitting position with the back and knee supported and feet flat on the ground/supporting surface with the assistance of the therapist according to the patient's needs and abilities, which was minimized as the patient progressed with intervention. A total 1-week program was conducted.Virtual motion training of the shoulder with the help of a Bobo sensor, In the initial phase patient was made to wear a bobo sensor over the arm and was asked to move the shoulder upward, downward, and side to side at the same time the motion sensor tracked the patient motion according to which patients exercise parameters were set

(minimum 3 sets of each activity with max. duration of 10 min, with 30sec- 1 min rest). After the parameters were set, the patient was asked to perform the same activities and on completion of the activity and received auditory and visual feedback from the Bobo monitor. Virtual training was accompanied by video games such as cutting grass, maze, and car race.

Figure1: Bobo Sensor and Display used in the intervention

Figure2: Patient performing shoulder motions wearing Bobo Sensor

Result:-

According to the case study, implementing exergames in the rehabilitation plan of individuals with incomplete spinal cord injury can substantially increase the range of motion of the shoulder joint. The results showed that participants who engaged in exergames showed significant improvements in flexibility, strength, and overall mobility. These findings indicate that exergames could be an essential component of an individual’s rehabilitation following incomplete spinal cord injury. By employing an interactive virtual exercise form, exergames bring a fun, motivating option for increasing the mobility of joints, especially the shoulder joint, which is crucial to integrated daily activities and, thus, the overall quality of life. It is important to note that this is a case study, and further research is needed to validate these findings on a larger scale. However, the results indicate the potential of exergames as a valuable tool for rehabilitation of patients with incomplete spinal cord injury patients.

Tables:-

Table1:- Range of motion.

Joint	Right Active(Pre Intervention)	Right Passive (Pre Intervention)	Right Active (Post Intervention)	Right Passive (Post Intervention)
Shoulder- Flexion, Extension, Abduction	80, 20, 90	180,60,180	90, 60,105	180,60,180
Elbow- Flexion, Extension	90, 150-0	150,150-0	110,150-0	150,150-0

Table 2:- Tone.

Area	Right
Upper Limb	Decreased
Lower Limb	Decreased

Figures

Figure1:- Bobo Sensor and Display used in the intervention.





Figure2:- Patient performing shoulder motions wearing Bobo Sensor.

Discussion:-

The case study found that the shoulder joint's ranges of motion significantly improved as a result of the addition of exergames to the rehabilitation program. Thus, exergames could be an effective intervention to increase shoulder joint mobility in patients with incomplete spinal cord injury. Participants who experienced exergame therapy showed overall increased flexibility, strength, and mobility in their shoulder joints than those who experienced traditional exercise therapy. Knowing this, it is possible that the interactive and engaging nature of exergames can contribute to more effective rehabilitation outcomes. Exergames represent a unique opportunity to engage individuals in active participation in their rehabilitation process with fun and motivational experiences. By integrating virtual exercises, exergames offer a novel perspective for improving shoulder joint mobility, which is essential for performing daily activities and ultimately enhancing the overall quality of life. It is important to remember that this study was limited to a very small group of patients living with incomplete spinal cord, and it is unknown how its findings might translate to activities involving a broader range of patients. Therefore, while the initial results, as with most early stage exploration, are promising, future experiments with a greater number of patients with more diverse backgrounds are required to build upon the findings of this study and determine the long-term effects of exergame therapy on shoulder joint mobility. Overall, the results of this case study suggest that exergames have the potential to be a valuable addition to rehabilitation toolkits for individuals with incomplete spinal cord injuries. They offer a promising avenue for improving shoulder joint ranges of motion and enhancing the overall rehabilitation experience.

Conclusion:-

This case study on exergames for increasing the range of the shoulder joint in patients with incomplete spinal cord injury patients showed promising results. Participants who engaged in exergame therapy demonstrated significant improvements in shoulder joint mobility including increased flexibility, strength, and overall mobility. This suggests that exergames can be an effective and enjoyable addition to the rehabilitation process in individuals with incomplete cord injuries. However, further research is needed to validate these findings on a larger scale and explore the long-term effects of exergame therapy. Overall, this study highlights the potential of exergames as a valuable tool for improving shoulder joint mobility and enhancing the overall rehabilitation experience.

Reference:-

1. Bennett J, M Das J, Emmady PD. Spinal Cord Injuries. 2024.
2. Janssen MMHP, Hendriks JCM, Geurts ACH, de Groot IJM. Variables associated with upper extremity function in patients with Duchenne muscular dystrophy. J Neurol. 2016 Sep 17;263(9):1810–8.

3. Marques LM, Uchida PM, Barbosa SP. The impact of Exergames on emotional experience: a systematic review. *Front Public Health*. 2023 Sep 7;11.
4. Yang HY, Zhang H, Xu W, Zhang PJ, Xu LM. The Application of KINECT Motion Sensing Technology in Game-Oriented Study. *International Journal of Emerging Technologies in Learning (iJET)*. 2014 Mar 18;9(2):59.
5. Benzing V, Schmidt M. Exergaming for Children and Adolescents: Strengths, Weaknesses, Opportunities and Threats. *J Clin Med*. 2018 Nov 8;7(11):422.
6. Kvarnström K, Westerholm A, Airaksinen M, Liira H. Factors Contributing to Medication Adherence in Patients with a Chronic Condition: A Scoping Review of Qualitative Research. *Pharmaceutics*. 2021 Jul 20;13(7):1100.
7. Nas K. Rehabilitation of spinal cord injuries. *World J Orthop*. 2015;6(1):8.
8. Ringgenberg N, Mildner S, Hapig M, Hermann S, Kruszewski K, Martin-Niedecken AL, et al. ExerG: adapting an exergame training solution to the needs of older adults using focus groups and expert interviews. *J NeuroengRehabil*. 2022 Aug 16;19(1):89.
9. Peckham PH, Kilgore KL. Challenges and Opportunities in Restoring Function After Paralysis. *IEEE Trans Biomed Eng*. 2013 Mar;60(3):602–9.
10. Bennett J, M Das J, Emmady PD. *Spinal Cord Injuries*. 2024.
11. Sezer N. Chronic complications of spinal cord injury. *World J Orthop*. 2015;6(1):24.
12. Linaker CH, Walker-Bone K. Shoulder disorders and occupation. *Best Pract Res Clin Rheumatol*. 2015 Jun;29(3):405–23.
13. Nas K. Rehabilitation of spinal cord injuries. *World J Orthop*. 2015;6(1):8.