

MINI REVIEW ON OUTCOME OF EXERGAMING ON PARKINSON'S DISEASE PATIENT'S REHABILITATION

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Abstract

This short review focuses on the effects of exergaming on rehabilitation in Parkinson's disease (PD). Exergames came from combining exercises and games. PD is a neurodegenerative condition. It is caused by loss of dopaminergic neurons in substantia nigra. 1-2 of 1000 people suffer from PD. It can be inherited genetically or sporadically. Physiotherapy involves several modalities in which

exergames is one of the intervention. It is important for us to find new interventions for treating the impairments caused due to PD. Exergames are virtual reality-based games and use sensors for motion recognition. These are the emerging technology and incorporating them in our treatment can make them exciting, can give them visual as well as audio feedback and provide different

challenges for patients. Although exergames are emerging technology and in high demands, its advantages, challenges and its effect on treatment of impairments caused by PD are discussed in this review.

Keywords: Exergames, Parkinson's disease, virtual-reality games, rehabilitation.

I. INTRODUCTION

Parkinson's disease (PD) is disorder of movement which is most prevalent and the central nervous system's second most frequent degenerative illness. Lewy bodies are found in substantia nigra in PD. Inhibition of voluntary movements is caused by loss of dopamine producing neurons in the substantia nigra. PD affects elderly mostly. 1-2 per 1000 people, majorly men, at any given movement are affected (1). PD is a disorder where there is heterogeneous neurodegeneration. PD can be genetically inherited i.e., familial PD which can be inherited in an autosomal dominant or autosomal recessive pattern or it can be idiopathic i.e., sporadic PD in which gene-environment interactions are thought to play a role. Familial PD is seen in 10 to 15% of all PD cases. 85-90% cases of all PD are idiopathic PD (2).

The main clinical signs of PD are bradykinesia, muscular rigidity, postural instability and resting tremors. The onset of symptoms is unilateral i.e., one side of the body shows the above features. The bradykinesia is slowness in initiation of movements and the speed decreases gradually over a period of time. Tremors in PD are present at rest which are of 4-6 Hz. Muscular rigidity can be cogwheel type in upper limbs and lead pipe type in lower limb. Apart from this PD also affects emotions, micrographia, facial muscles which give a mask like face appearance, decreased gastrointestinal tract mobility, urinary incontinence, dystonia, hallucinations, deterioration of cognitive functions, etc. (3). The PD is treated with levodopa, physiotherapy and occupational therapy (4).

Physiotherapy involves several modalities like conventional physiotherapy, treadmill training, strategy training, hydrotherapy, exergaming, balance and gait training, aerobic exercises, dual training and other physiotherapy techniques (5). Exergame came from combining exercise and games. A vast number of exergames are available in market like Nintendo Wii Remote, Microsoft Xbox Kinect sensor, Helicopter, Pong, and Baseball Catch, etc. These exergames helps in improving quality of life, balance,

cognitive function, physical activity, health and wellness (6). In this review literature we are going to see if there are any significant effects of exergaming in treating the impairments related to PD.

II. EXERGAMING:

"Exergaming" is the practise of incorporating physical activity into a video game that needs active core and/or body motions to influence the in-game experience.

Exergames offer the potential to allow people with disabilities to participate in workouts that are of sufficient "dose potency" to accomplish moderate–vigorous intensity physical activity while remaining enjoyable to play and can be carried out in a relatively safe home environment (7). Sensors that allows for on-screen directing artefacts and recurrence in instantaneous visual feedback, while a patient is performing an exercise counters to provide feedback to the patient on his or her performance are important for rehabilitation (8).

Wearable sensors which are placed on body parts can be used to measure gait, balance, and range of motion during activities like walking, sit to stand, turning, etc. (9). Exergames typically use sensors which can be place on body or distant sensors which are usually acceleration measuring sensors, sensors which can measure heart rate and camera to know the position of the player (10). Body tracking sensors are used to recognize and evaluate the patient's posture while doing strengthening exercises (11).

III. EFFECTS OF EXERGAMING ON REHABILITATION OF PD:

PD is a neurodegenerative illness that manifests in both motor and non-motor symptoms. Pachoulakis et al.

Balloon goon is a score-based game in which to blow up balloons that fall randomly along four vertical posts, the player utilises controlled arm and leg gestures reminiscent of "punches" and "kicks". According to the game, it improves movement, coordination, and mobility, as well as mental skills, by challenging players to make the best judgement possible within a certain amount of time. But there are very few Kinect based games specifically designed for PD (12). In the therapy of postural instability, exergames and other virtual reality technologies may be useful by allowing users to interact with an environment which is computer-simulated directly. Shih et al. The patients were asked to play four games in which patient had to touch a stationary object, touch a moving object, avoiding obstacles and marching at one place. The games require motor abilities, balance, postural stability and cognitive functions, so these can be tested as well as can be improved by increasing the difficulty levels in the games. The literature showed increased postural stability in the patients using exergames than the convenient balance training (13-25).

Ribas et al. used seven Wii Fit games in the exergaming intervention showed that there was significant enhancement in balance and fatigue but they were not present after a 60 days follow-up. It implies after a period of treatment patient should continue doing exercises to maintain the benefits of the treatment (26-35). Patients suffering with Parkinson's have difficulties in doing activities involving upper extremities. They suffer from bradykinesia, micrographia, tremors, cogwheel rigidity leading to upper extremity impairment. Allen et al. exergames which can be played on tablet and uses finger and arm movements were introduced to patients. The study showed no significant enhancement in functional activities other than increased speed and decreased accuracy. There should be more specificity in game regarding the accuracy of patients as it will give them feedback regarding their mistakes and can improve them (36-47). Ferraz et al. compared the results of functional training, exercise using a bicycle and exergames on potential of walking in PD patient. He used Kinect based adventure games. The study showed improvement in patients of all three treatment strategies. But the exergames are more exciting and fun as they can provide different challenges to them compared to other two (16). As, PD affects motor system primarily, it leads to impairment of hands which makes the patient unable to do the skilful movements of hands. van Beek et al used exergame to improve the dexterity. He observed improved dexterity after a 4 week training which also lead to improvement in quality of life of patients (17). PD also impairs the cognitive function. Schaeffer et al. used virtual smash, light race and kardio boxing to study if these games improve the dual tasking and attentional deficits. The literature showed that after training with these exergames there was significant enhancement in primary cognitive dual tasks and concentration capacity (18).

IV. SUMMARY AND FUTURE PERSPECTIVE:

Physiotherapy plays an important role in rehabilitation of patients suffering with PD. Exergames is one of the many modalities used by physiotherapist for rehabilitation. But are they useful is the bigger question. From what we have examined in this literature, exergames can be an effective treatment for impairments caused due to PD. The

exergames showed significant improvement in patient's balance, gait, ROM, speed of movements and postural stability. But they also have a lot of drawbacks related to cost, availability, specificity, supervision, accuracy and patient's will to regularity in doing the exercises. The equipment present in the market are very expensive making them unavailable for majority of population. There are very few exergames present specifically for PD patients and these leads to inaccurate results of interventions. From what we gained from above literature the exergames are certainly not yet to the level where they can be played at home without supervision of a therapist to guide them. The exergames needs to be played regularly to maintain the gains of the treatment, but it is difficult to supervise once the patients left the clinic and are asked to play the exergames at home as they might show negligence towards it. This negligence can lead to loss of whatever the progress is made from the treatment. This are some of the obstacles that are currently present and affects the patient's outcome of treatment. But if we overcome all these obstacles exergames can be a very successful intervention for PD.

DECLARATION OF CONFLICT OF INTEREST:

The author declares that there is no financial/personal interest or belief that could affect their objectivity and influence the work reported in this paper.

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