



Effectiveness of Virtual Reality Training for Hand Dexterity in Parkinson's Subjects

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Abstract: Our aim of the study is to determine the effectiveness of virtual reality training for hand dexterity in Parkinson's subjects. Parkinson's disease is one of the most common neurodegenerative disorders. Parkinson's disease (PD) includes multi level impairments in functional, motor activities which leads to worsening the patient's physical and psychological disabilities, more than 10 million people worldwide are living with Parkinson's disease. Hand dexterity is as essential as walking ability or postural stabilization or maintaining independence and quality of daily living activities. A comparative study was done with 20 samples. The study was conducted in ACS Medical College and Hospitals, Physiotherapy OP, Krrish Physiotherapy clinic. The duration of treatment was 8 weeks. Both male and female individuals with Parkinson's disease in concern about hand dexterity difficulty, between the age of 50-55 were included. PD with other neurologic diagnosis, Cognitive impairments, Vision impairments, Uncooperative medication, Cardiac problems, uncooperative were excluded. The outcome measure tools are Box and Block test (BBT) and Chedoke Arm and Hand activities Inventory(CAHAI-13). Based on inclusion and exclusion criteria and outcome measures, 20 subjects were divided into two groups. Group A (10 subjects) were treated with virtual reality training using Leap Motion Controller for 4 days a week for 2 months and Group B (10 subjects) were treated with conventional physiotherapy for 4 days a week for 2 months. On comparing the mean values of Group A & Group B by using CAHAI-13 and BBT score, the Virtual reality Training seems to have shown better results in manual dexterity in Parkinson's subjects. People with mild to severe disability Parkinson's have reduced dexterity and problems with hand function.

Keywords: Parkinson's disease, virtual reality, Leap motion controller, hand dexterity, conventional physiotherapy.

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1. INTRODUCTION

Parkinson's disease is defined as a chronic neurodegenerative disorder due to destruction of dopaminergic neurons, at the basal ganglia. The Primary neurotransmitter Dopamine is responsible for transmitting the appropriate information for the correct control of movements.^{1,2} Parkinson's disease is considered as most common neurodegenerative disorder after Alzheimer's disease, most common movement disorder.^{3,4} Parkinson's disease prevalence increases steadily with age, some difference in prevalence by geographic location and sex. Parkinson's disease is characterized by four cardinal signs; Tremor, bradykinesia, rigidity and postural instability. It also shows loss of Gross and fine motor functions. Amongst the cardinal symptoms of Parkinson's disease, bradykinesia (i.e. slow movement) is considered to have a large adverse influence on the position of life. Short presentations of visual or auditory stimuli at the onset of the movement are commonly used as upper extremity movement cues. Hand dexterity- Fine and Manual dexterity, one of the factor for predicting physical level of daily living in Parkinson's persons.⁵ A few studies have shown that Parkinson's persons have manual deficits, reduced finger torque and decreased interdigit individuation compared to age-matched healthy person's.⁶ Parkinson's people experienced limitation in upper extremity, functions includes both manual and fine dexterity. Some studies have reported that, impairment in manual and fine dexterity affects the activities of daily living of Parkinson's person.⁸ Performance on a manual dexterity test shows an objective behavior marker that helps in detecting the prodromal stage of Parkinson's disease in individuals.^{9,10} At the onset, the clinical motor deficits are unilateral in Parkinson's person and later leads to bilateral deficits. These deficits can interfere with functional activities such as manipulation, reaching, grasping, postural stability, gait, transfer performance.^{11,12} In specific, due to cognitive and motor impairments, many Parkinson's patient have poor functional abilities in upper extremities, which are used for reaching, grasping and manipulating objects.¹³⁻¹⁵ Dexterity is an important components of hand function and is a manual skill that is required for coordination of fine and gross movements.¹⁶ It is achieved through repetitive movements and experience in motor learning. The pathology in loss of hand dexterity shows the degrading consequences of cortical and subcortical regions. Patients with Parkinson's disorder become dependent on caregivers due to their motor and cognitive impairments interfere with the ability to perform daily activities.¹⁷⁻¹⁹ Though dopaminergic treatment can improve the cardinal sign of Parkinson's disease, Physical therapy has been proved to be able to enhance manual dexterity, hand and eye coordination in Parkinson's patients.²⁰ In neuro rehabilitation, technology-based rehabilitation systems, such as virtual reality (VR) are promising and may able to deliver a client centered task-oriented rehabilitation.²¹ Several studies have shown that virtual reality training helps to facilitate motor learning, functional activities and neuroplasticity through intensity during task-oriented training. When combined with robotics, movement tracking, and sensing glove systems, virtual reality simulations can provide an engaging and motivating environment in which the motion of the limb depicted in the virtual world is a duplicate of the motion produced in the actual world by way of the subject. Virtual environments (VEs) can be used to present multimodal data in a complicated way. Sensory information to the user have been employed in military training, entertainment, and other

applications. Simulations, surgical training, spatial awareness training, are most recently used as a therapeutic intervention for phobias. In recent years, the field of virtual reality (VR) has grown immensely. Practical applications for the use of this technology encompasses many fields, from aviation training and military applications, to industrial training in machine operation, to medicine, where surgeons can be trained in surgical techniques using VR systems. One of the newest fields to benefit from the advances in VR technology is that of medical rehabilitation. In the span of just a few years, the research has advanced from potential benefits of using such technology, to the development of actual working systems, testing of prototypes, and early clinical results with patients who have used some of these systems. Leap Motion Controller (LMC) system, uses a sensor that captures the movement of the patient's forearm and hand without the need to place sensors or devices on the body. This displays a virtual image of the upper limbs on a computer screen and the patient is prompted to perform movements according to the functional task proposed.^{22, 23} This system provides main advantages like portability, ease of use, commercial availability, low and non-invasive nature. Chedoke arm and hand activity inventory (CAHAI 13), measure is to evaluate the functional ability of the affected arm and hand to perform tasks that have been identified.²⁴ It is also designed to encourage bilateral function. Box and Block Test (BBT) measures unilateral gross manual dexterity. It is a quick, simple and inexpensive test. It is thought to tap spatial visualization ability and motor functions²⁵. Thus our study is to determine the effectiveness of virtual reality training for hand dexterity in Parkinson's subjects

1.1 Equipment for Vr Systems in Motor Rehabilitation

A virtual environment (or virtual reality) is a computer-generated simulation of a real-world setting that may be experienced through a human-machine interface, by the user to produce VR simulations of differing degrees of complexity, a range of hardware and software components can be used. In the actual world, we learn about our surroundings directly through our senses—vision, hearing, touch, proprioception, and smell—in the virtual world, we use the same senses to learn about the virtual world via a human-machine interface (e.g., head-mounted visual display). Information can be provided using the human-machine interface depends on the type of gadgets that have been chosen for use, unique to one or more senses. The interface is then used to guide the participant's interactions within the virtual world. The virtual environment's input can likewise be used in combination with real-world sensory inputs to create a hybrid input to the central processing unit system of nerves (CNS). A variety of equipment may be utilized to make different varieties of virtual environments with different capabilities and purposes. Several available books provide complete and detailed descriptions of available VR equipment 1–3; therefore, only cursory descriptions are provided here. The basic components for VR systems are a computer, usually with a special graphics card that may allow fast computation and drawing of three-dimensional (3-D) images, display devices through which the user views the virtual environment, hardware devices that may be want to monitor movement kinematics, or provide simulations of haptic and force feedback to participants, and, of course, specially written software that enables all these component to work in synchrony²⁶

1.2 Display Devices

The simplest visual display device is a desktop computer monitor, using an enhanced 2-D graphics display. Although such displays will not be as realistic as a true-stereo 3-D display, the sense of depth can be enhanced through the use of depth cues such as perspective, relative motion, occlusion, and aerial perspective. VR provides a powerful tool with which to provide participants with all of these elements—repetitive practice, feedback about performance, and motivation to endure practice. In particular, in a virtual environment, the feedback about performance can be augmented—that is, enhanced relative to feedback that would occur in real world practice. A wide variety of methods have been used to exploit aspects of VR technology to enhance motor learning in people with disabilities through real time feedback (i.e., concurrent with task performance) and/or “knowledge of results” feedback. Knowledge of results feedback occurs immediately following a trial or block of trials. Feedback has been extensively investigated and there is general agreement that it improves learning rate.²⁷

2. METHODOLOGY

2.1 Ethical Considerations

The manuscript is approved by the Institutional Review board of faculty of physiotherapy (IRB REF NO: MPT (NEUROLOGY)-014/PHYSIO/ IRB/2020-2021). All the procedures were performed in accordance with the ethical standards of the responsible ethics committee both (Institutional and national) on human experimentation and the Helsinki Declaration of 1964 (as revised in 2008).

2.2 Sampling and Participants

It is a comparative study done with 20 samples. Faculty of Physiotherapy, Dr.MGR Educational and Research Institute, review board approved this study, and all participants signed an informed consent form before the experiment began. The study was conducted in ACS Medical College And Hospitals, Physiotherapy OP, Krrish Physiotherapy clinic.

Inclusion criteria

Inclusion criteria were 1.Idiopathic Parkinson disease 2.Age group 50—55 years 3. Both male and female 4.Hoehn and yahn scale 2-3 stage 4. Hand dexterity difficulty The duration of treatment was 8 weeks. Patient who met the inclusion criteria were considered and randomly divided into two groups, Group A (10 subjects) were treated with virtual reality training using Leap Motion Controller for 4 days a week for 2 months and Group B (10 subjects) were treated with conventional physiotherapy for 4 days a week for 2 months

Exclusion Criteria

Exclusion criteria were 1.PD with other neurologic diagnosis, 2.Cognitive impairments, 3.Vision impairments, 4.Uncooperative medication, 5.Cardiac problems, 6.uncooperative.The outcome measure tools are Box and Block test (BBT) and Chedoke Arm and Hand Activities Inventory(CAHAI-I3).

2.3 Intervention

Virtual Reality Training

Virtual reality using Leap Motion Controller consists of a series of video games for Hand Dexterity includes, PianoGame,GrabGame,PinchGame,SequenceGame,ReachGame²⁷.

Piano game

In this game, a piano with 10 keys stimulates each of fingers corresponding to one finger of each hand. During the game, the highlighted key indicated must be pressed by the appropriate finger from the little to the thumb. Keeping the hand open and lowering the finger will take down the key until it sounds.(Fig 1: Piano Game)

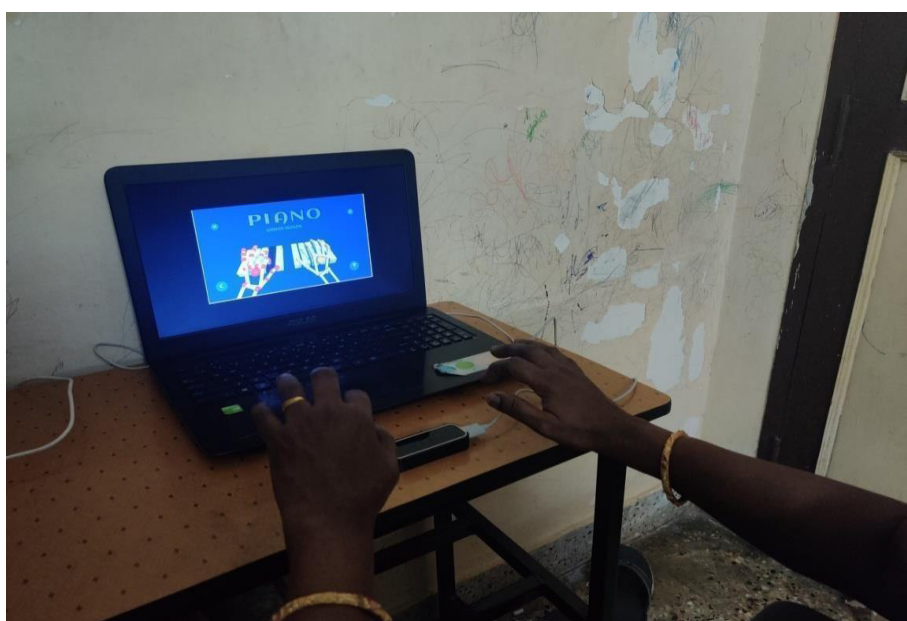


Fig 1: Piano Game

Grab Game

Fig 2 : Grab Game

In this game, A set of cubes is arranged in a layout, a coloured sphere is shown in the Centre of the screen. The patient should reach the indicated cube by gesture of fingers flexed and fist closed to move the grabbed cube towards the center sphere. Then open the hand with all the fingers to release the cube.(Fig 2 : Grab Game)

Pinch Game

The patient must touch the index finger with the thumb from a initial position with extended fingers.(Fig 3:Pinch Game)

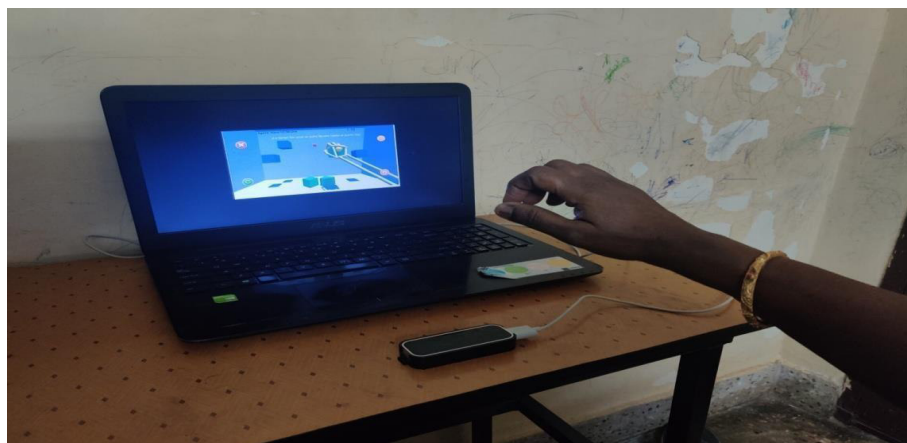


Fig 3:Pinch Game

Sequence Game

The patient's aim is to memorize the sequence that is reproduced through changes of the coloured cube that

appears on the screen. At the end of the sequences the patient should repeat it, by reaching the cubes in the same order in which they are shown. (Fig 4: Sequence Game)

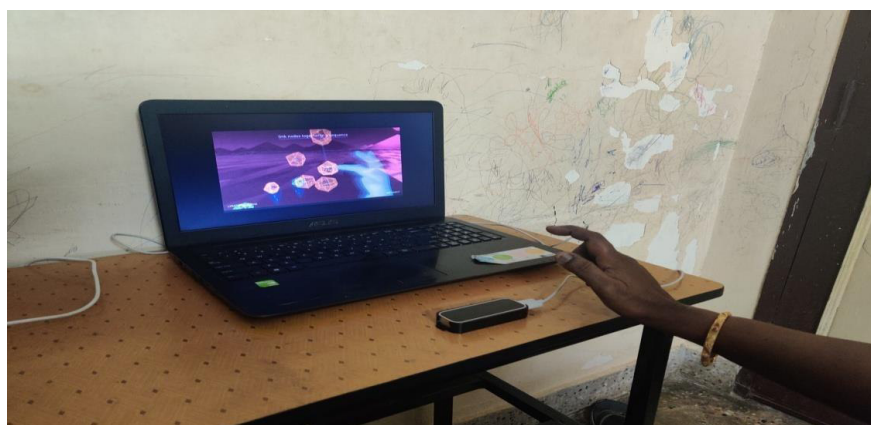


Fig 4:Sequence Game

Reach Game

In this game, The patients virtual finger must touch the indicated cube among several cubes that appear on screen, As the cubes are reached, the fall on the floor, the next

target cube is indicated until the last of them has been dropped. The cubes on the screen are located at different heights and depths. The highlighted one is the goal to be touched and the rest of them become obstacles to be avoided. (Fig 5: Reach Game)

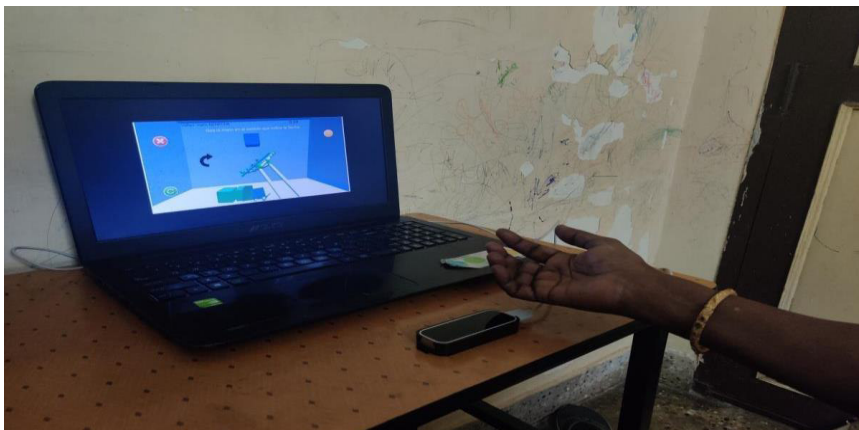


Fig 5:Reach Game

Duration

40 minutes of virtual training, for 4 days in a week for 8 weeks.

Low Chart of Virtual Reality Execution

Conventional Therapy

Exercise like active exercises of hand and arm, Theraputty training, upper limb stretching.

EXERCISES

1. Rest arm on a table; Put the palm of your hand flat on the table. Then turn your palm up .Do not lift your

elbow from the table. Repeat with your hand. Hold for 3 seconds. Repeat for 5 times.

2. Rest forearm on a table: Lift your hand at the wrist with your relaxed. Lower your hand and bring it to the starting position. Hold for 3 seconds .Repeat for 5 times.
3. Rest right forearm on a table with left hand holding wrist: Keeping your right hand flat on the table , move it from side to side .Repeat with left hand. Hold for 3 seconds .Repeat for 5 times
4. Bend fingers to make a tight fist :then release and straighten your fingers. Hold for 3 seconds . Repeat for 5 times

Theraputty Exercises



Fig 5:Theraputty Exercises

1. Finger press (flexion): Place Theraputty into palm to the hand and press fingers through the putty until the fingertips reach the palm, release fingers and repeat for 5 times.
2. Finger extension: Keep fingers straight while using the palm to roll out a tube of Theraputty. Repeat for 5 times.
3. Rooftop exercise: From the Theraputty into a ball between fingers and thumb, form rooftop using

- straight fingers, leaving the thumb underneath, press all fingers down toward the thumb. Repeat for 5 times.
4. Finger squeeze/spread; Adduction: Place between two spread fingers. using scissors like motion ,try bringing the two fingers together. repeat until all fingers have been exercised.
 5. Abduction: Form Theraputty on a table, bunch the fingertips together and place into the putty, spread out all the fingers at once, enlarging as much as possible. Repeat for 5 times.

DURATION

40 minutes of upper limb conventional training, for 4 days a week for 8 weeks.

3. Data Collection and Outcome Measures

The outcome measure tools are Box and Block test (BBT) and Chedoke Arm and Hand activities Inventory(CAHAI-13).The box and block test (BBT) measures unilateral gross manual dexterity and may be used for one of a kind tests, together with sufferers with PD. The BBT is a wooden box divided into compartments and a hundred and fifty blocks. The text include transferring the most number of blocks one-by-one from one compartment of a box to another of an identical size within 60 s. The test begins with the unaffected UL to register scores and both sides are tested. The CAHAI is a performance test using functional items. It is not designed to measure the client's ability to complete the task using only their unaffected hand, but rather to encourage bilateral function. This test consists of 13 functional tasks.

Table 1: comparison between pre-test value of group a & group b

SI NO	Outcome	Group a (pre-test)	Standard deviation Group a (pre-test)	Group b (pre-test)	Standard deviation Group b(pre-test)
1	Cahai-13	65.20	2.14	64.60	2.01
2	Bbt-left hand	65.10	1.79	65	1.49
3	Bbt-right hand	66.10	8.43	66	1.49

Table 1 shows the pre-test value of CAHAI-13 is 65.20 & 64.60, BBT-LEFT HAND is 65.10 & 65 and BBT-RIGHT HAND is 66.10 & 66.

Table 2: comparison between pre and post of cahai-13, bbt-left & Right hand in experimental group

S.no	Group-a (experimental)	Mean		Standard deviation		Paired “t” value	“p” value
		Pre- test	Post- test	Pre- test	Post- test		
1.	Cahai-13	65.20	79.20	2.14	1.47	-22.778	0.0001
2.	Bbt-left hand	65.10	77.30	1.79	0.823	- 20.589	0.0001
3.	Bbt-right hand	66.10	78.60	8.43	0.699	- 23.036	0.0001

Table 2 shows the comparison between the pre and post-test of CAHAI-13, BBT-LEFT AND RIGHT HAND in the experimental group. The mean value of CAHAI-13 is 65.20 & 79.20, BBT-LEFT HAND is 65.10 & 77.30, and BBT –RIGHT HAND is 66.10 & 78.60.

Table 3: comparison between pre and post of cahai-13, bbt-left & Right hand in control group

S.no	Group-b (control)	Mean		Standard deviation		Paired “t” value	“p” value
		Pre- test	Post- test	Pre- test	Post- test		
1.	Cahai-13	64.60	79.20	2.01	3.28	-9.273	0.0001
2.	Bbt-left hand	65	71.60	1.49	1.26	-11.00	0.0001
3.	Bbt-right hand	66	72.60	1.49	1.26	-11.00	0.0001

Table 3 shows the comparison between the pre and post-test of CAHAI-13, BBT-LEFT AND RIGHT HAND in the Control group. The mean value of CAHAI-13 is 64.60 & 79.20, BBT-LEFT HAND is 65 & 71.60, and BBT–RIGHT HAND is 66 & 72.60.

Table 4:comparison of post test values between group-a and group-b

S.no	Post test	Mean		Standard deviation		Independent “t” test	“p” value
		Group a	Group b	Group a	Group b		
1.	Cahai-13	79.20	72.90	1.47	3.28	5.537	0.0001
2.	Bbt- left hand	77.30	71.60	0.823	1.26	-3.806	0.0001
3.	Bbt- right hand	78.60	72.60	0.699	1.26	-1.768	0.0001

Table 4 shows the comparison between the post-test values of CAHAI-13, BBT – LEFT & RIGHT HAND between the experimental and control group. Post-test values of CAHAI-13, BBT – LEFT & RIGHT HAND in experimental group are 79.20 & 72.90 (CAHAI-13), 77.30 & 71.60 (BBT – LEFT HAND), 78.60 & 72.6 (BBT- RIGHT HAND).

4. STATISTICAL ANALYSIS

Based on inclusion and exclusion criteria and outcome measures, 20 subjects were divided into two groups. Group

A (10 subjects) were treated with virtual reality training using Leap Motion Controller. The outcome measure tools are Box and Block test (BBT) and Chedoke Arm and Hand activities Inventory (CAHAI-13). The collected data were

tabulated and analyzed using IBM SPSS VERSION 20.0 SOFTWARE. The collected data were analyzed and tabulated with the descriptive and inferential statistics. For the descriptive statistics, the mean and standard deviation were calculated and for the inferential statistics, the parametric variables were treated with t-test..

5. RESULTS

A total of 20 Parkinson's subjects were included in the study, with the age group ranging from 50 to 55 years. All the patients involved were assessed using Chedoke arm and hand activity inventory 13 (CAHAI-13) AND Box and block test (BBT) as pre-test and post-test measures. Table 1 shows the comparison between the pre-test values of Group A & Group B, the pre-test value of CAHAI-13 is 65.20 & 64.60, BBT-LEFT HAND is 65.10 & 65 and BBT-RIGHT HAND is 66.10 & 66. Table 2 shows the comparison between the pre and post-test of CAHAI-13, BBT-LEFT AND RIGHT HAND in the experimental group. The mean value of CAHAI-13 is 65.20 & 79.20, BBT-LEFT HAND is 65.10 & 77.30, and BBT -RIGHT HAND is 66.10 & 78.60. The CAHAI-13, BBT-LEFT & RIGHT HAND in the experimental group has the P value < 0.005 which is significant. Table 3 shows the comparison between the pre and post-test of CAHAI-13, BBT-LEFT AND RIGHT HAND in the Control group. The mean value of CAHAI-13 is 64.60 & 79.20, BBT-LEFT HAND is 65 & 71.60, and BBT-RIGHT HAND is 66 & 72.60. The CAHAI-13, BBT -LEFT & RIGHT HAND in the control group has the P value < 0.005 which is significant. Table 4 shows the comparison between the post-test values of CAHAI-13, BBT - LEFT & RIGHT HAND between the experimental and control group. Post-test values of CAHAI-13, BBT - LEFT & RIGHT HAND in experimental group are 79.20 & 72.90 (CAHAI-13), 77.30 & 71.60 (BBT - LEFT HAND), 78.60 & 72.6 (BBT- RIGHT HAND). A post-test value of CAHAI-13, BBT -LEFT AND RIGHT HAND of experimental over the control group has the P value < 0.005 which is significant.

6. DISCUSSION

This study presents a Virtual Reality system aimed at evaluating hand dexterity in individuals with Parkinson's disease. A main outcome obtained here is that the system is reliable. This is important, since a basic requirement of any VR system to be useful in motor system Research and potentially treat patients. Upper-extremity rehabilitation is challenging. Parkinson's disease (PD) is the second most common neurodegenerative disorder in the elderly, and the most commonly seen movement disorder in neurology clinics³. Parkinson's disease (PD) patients have deficits in controlling acceleration, a drawing task was used in which target size, frequency, and weight of pen⁸. After a stroke, 75 percent to 95 percent of individuals learn to walk again, although 55 percent continue to have issues with upper extremity function. Rehabilitation is difficult due to the complexity of sensorimotor control required for hand function and the vast spectrum of manipulative abilities that can be recovered²⁸. Skillful object manipulation requires precise coordination and control of the Wngertip forces. Previous studies have shown that , individuals with Parkinson's disease (PD) exhibited increased variability while coordinating multiple force control tasks (Benecke et al. 1986), controlling the rate of isometric force production (Fellows et al. 1998; Park and Stelmach 2007; Stelmach and Worringham 1988), and performing multi-Wngered grasping

tasks (Rearick et al. 2002)⁶. Walking promotes the integration of both the affected and unaffected limbs, whereas functional upper-extremity tasks can be conducted with one limb, allowing the user to delegate a task to the remaining good limb while neglecting the affected one. Experimental interventions using novel technologies for disease treatment and rehabilitation should be analyzed for efficacy and safety. It's critical to tailor virtual reality training programmes to the target population's traits and demands. Many virtual reality programmes for people with hemiparesis are designed to improve motor control, strength, and dexterity, with an emphasis on accuracy rather than speed. A study by Sara Matoes-TosetoT et al, concluded that Participants received a 15-minute exercise session focused on hand training using therapeutic putty. Participants allocated to the control group performed active upper limb exercises. Behavior of Group A in VR displayed the same usual features reported in the real world. Parkinson's disease were prone to hand dexterity during were to hand dexterity during reaching or manipulating objects¹⁹. A study reported that, among the motor deficit often seen in PD patients often report difficulties with hand dexterity. In contrast to the previously released small realizability Study of PD, 29 participants including our study High adherence rate demonstrates excellent realizability (99%) Training protocol and high level of active participation. The latter represents the good commitment and high motivation of the participants, which are important components of the participants.²⁸ A study by Edwin Daniel Ona et al, concluded Leap motion controller piano game , pinch game. Reach game, sequence game, grab game improves the finger movements involving a fine motor unilateral and bilateral coordination and fine manual dexterity²⁹. A study by Yoo- Im-Choi et al, concluded that, Manual dexterity and activities of daily living showed a positive correlation in individuals with Parkinson disease. The results of his study suggested that manual dexterity is an important factor for predicting physical performance in daily living in persons with Parkinson disease³⁰. Behavior of Group A in VR displayed the same usual features reported in the real world. Parkinson's disease were prone to hand dexterity during reaching or manipulating objects. The characteristic difference in hand dexterity between Group A were revealed on post testing. Virtual reality-based exergaming may enhance fine movements, decrease the medications dosage and provide an additional non-subjective evaluation¹⁰. Although the system has allowed us to analyze the characteristics of a motor act, This study's ultimate goal is to modify the performance of a hand movement, especially in cases where movement is already pathologically altered. Dexterity evaluation is critical in assessment of hand function during rehabilitation of people with Parkinson's. The system permits modification of parameters of the movement performed by the patient, which hopefully will improve motor impairment after imitation training. This hypothesis which is ready to be confirmed in the near future, seems to be supported by the excellent level of immersion observed. This study suggests that VR works on both to study and treat motor disorders. This allows inclusion of more complex virtual elements to interact either with physiological and damaged motor systems and its use in non- naturalistic environments such as brain damage. The pre-test value of CAHAI-13 is 65.20 & 64.60, BBT-LEFT HAND is 65.10 & 65 and BBT-RIGHT HAND is 66.10 & 66. The mean value of CAHAI-13 is 65.20 & 79.20, BBT-LEFT HAND is 65.10 & 77.30, and BBT -RIGHT HAND is 66.10 & 78.60. The mean value of CAHAI-13 is 64.60 & 79.20, BBT-LEFT HAND is 65

& 71.60, and BBT–RIGHT HAND is 66 & 72.60. Post-test values of CAHAI-13, BBT – LEFT & RIGHT HAND in experimental group are 79.20 & 72.90 (CAHAI-13), 77.30 & 71.60 (BBT – LEFT HAND), 78.60 & 72.6 (BBT- RIGHT HAND). On comparing the mean values of Group A & Group B by using CAHAI-13 and BBT score, the Virtual reality Training seems to have shown better results in manual dexterity in Parkinson's subjects. People with mild to severe disability Parkinson's have reduced dexterity and problems with hand function. A post-test value of CAHAI-13, BBT – LEFT AND RIGHT HAND of experimental over the control group has the P value < 0.005 which is significant. Our findings have implications for training people with mild-to-moderate Parkinson's disease. Because more clinics now use virtual reality equipment for motor rehabilitation, therapists need to be aware of its benefits and limitations. Our results suggest that practicing fast movement in virtual reality can be generalized to fast reaching for stationary objects in physical reality, but not to reaching for moving objects, because the visuomotor coordination patterns involved are somewhat different between virtual reality and physical reality. Additional research is needed to examine whether more extensive virtual reality training with targets that move at different speeds helps people with Parkinson's disease improve the speed of their motor performance as well as their visuomotor coordination. In addition, fast-moving targets are effective for increasing movement speed in people with Parkinson's disease.

7. CLINICAL VALUE

Physiotherapy may be beneficial to persons with Parkinson's disease. It proves small-scale upper-extremity actions, such as writing, in addition to gait and balance. Functional clinical tests, such as the Jebsen test for hand dexterity or a precision grip-and-lift task, are frequently used to assess occupational and physiotherapeutic activities and outcomes. The latter has a good relationship with the UPDRS. These tests, on the other hand, necessitate the use of experienced and trained experts to conduct the assessments. Despite this, the participants were able to complete Box and Blocks Block test (BBT) and Chedoke Arm and Hand activities Inventory (CAHAI-13). When the results are being compared to large databases and evaluated, one must also consider that the data are 275 subjectively assessed by different experts

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not taking into account that their assessment may even vary 276 with daily wellbeing.

8. LIMITATION OF THE STUDY

Small sample size, Study duration is short, Long time follow up of the patients was not possible, Age group is limited.

9. RECOMMENDATION OF THE STUDY

Large sample size can be used, Long duration of the study is recommended, With regular and long term follow up is recommended, More age group should be included.

10. CONCLUSION

The Virtual reality Training includes series of game like Piano game, Reach game, Pinch game improves bilateral fine and gross motor function and coordination. Sequence games improved the visual sequential memory. Grab game improved gross manual dexterity and spatiality. The serious games implemented in this study are a versatile tool in neuro-rehabilitation processes. Hence by VR, the quality of life is improved in Parkinson's patients as hand dexterity is one of the main components in Activity of Daily Living.

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12. AUTHORS CONTRIBUTION STATEMENT

Prof. Dr.C.V.Senthilnathan and G.vaishnavi conceptualized the idea and guided this study. G.Vaishnavi, Saranya.P carried out the research study and drafted the manuscript. K. Kamatchi and V.Pavithralotchani discussed the methodology and result. I.Deepa, k.Pradeepa Contributed in analyzing data.

13. CONFLICT OF INTEREST

Conflict of interest declared none.

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