Application Of Laser Pointer Visual Biofeedback On Eye Hand Co-Ordination In Male Parkinson Disease Patients – An Observational Study

[1*] C.Mohana, [2]Dr.K.Narayanasamy , [3] S.K Rajkumar, [4]S.Meena, [5]Dr.S.Kalpana

[1]Assistant professor, Swamy Vivekanandha Physiotherapy College Namakkal, Tamil Nadu. (Affiliated to The Tamil Nadu Dr M.G.R Medical University, Chennai.)
[2]Vice – Chancellor- The Tamil Nadu Dr MGR Medical University
[3]principal , Swamy Vivekanandha Physiotherapy College
[4]professor[1] Swamy Vivekanandha Physiotherapy College
[5]Research director , The Tamil Nadu Dr MGR Medical University, Chennai.
Corresponding author : C.Mohana
ORCiD : 0009-0003-2884-1100

ABSTRACT :

INTRODUCTION :
Biofeedback enables the individual to increase awareness and it helps to refine movement sequence. This study involves the use of visual biofeedback with laser pointer for improving eye hand coordination in Parkinson disease patients .parkinson disease is manifested by many cardinal features and one of the most common feature is lack of ye hand coordination . parkinson disease patients unlike normal subjects were unable to maintain normal trunk alignment without visual orientation. Hence treating eye hand coordination is essential for healthy living of Parkinson disease patients .

METHODS : . It is an observational study design. 20 subjects were screened and 10 subjects were selected based on the inclusion and exclusion criteria. The study setting was at OP Department of Physiotherapy.Parameter used to test eye hand coordination is finger to nose test . Inclusion criteria includes male parkinson disease patients of age group 60- 80years, patients with intact visual and auditory sensation , patients with eye hand coordination score greater than 2, patients without any other neurological disorders, patients without balance disorders. Exclusion criteria includes patients with age group less than 50 and those with neurological disorders, patients with lack of visual and auditory response.The study duration is about 10 weeks and treatment duration is 6 weeks .The method of intervention applied was laser pointer visual biofeedback training with hand and forehead pointer .

RESULTS :
The eye hand coordination is assessed using finger to nose test. Based on pretest and postest analysis , the application of laser pointer visual biofeedback training is found to be statistically significant. The pretest and posttest mean are 3.44 and 1.78. The pretest and post test standard deviation are 0.73 and 0.67. The calculated t value is 5.96 and table t value is 2.306. As the calculated t value is greater than table t value , the result was statistically significant.

DISCUSSION :
The laser pointer provides immediate visual cues, helping brain synchronize sensory input (visual tracking) with motor output. Repeated practice strengthens neural pathways responsible for eye – hand coordination , improving precision and reaction time. By connecting visual input (the laser dot) with motor output (neck and eye movement), it enhances the ability to integrate these two systems, a key component of eye-hand coordination.

INTRODUCTION :
PD is multifactorial disease , with both genetic and environmental factors playing role. Age is the biggest risk factor for PD, with median age of onset being 60 years of age . The incidence of disease rises with age to 93.1 (per 100,000 person – years) in age group between 70- 79 years. The other mechanism behind Parkinson disease includes alpha synnuclein misfolding and aggregation, mitochondrial dysfunction , dysfunctional protein clearance system , ubiquitin proteasome system, autophagy- lysosome system, neuroinflammation .PD

affects 1 to 2 people per 1000 at any time, the prevalence with age to affect 1% of population above 60 years . 5 to 10% have genetic predisposition .Based on GBD survey , it has been found that parkinnson disease will become pandemic by the year 2040 .Although many brain areas are affected in Parkinson disease, the most common symptom results from loss of neurons in an area near the base of brain called substantia nigra. The neurons in this area produce dopamine .Dopamine is the chemical messenger that transmits signals in the brain to produce smooth, purposeful movement . Studies have shown that most people with PD have lost 60 -80 % of more of dopamine producing cells in sustantia nigra by the time symptoms appear. The people with PD lose the nerve endings that produce the neuro transmitter norepinephrine , the chemical messenger to part of nervous system that controls many automatic functions of the body such as blood pressure and pulse. Based on World Health Organisation, Parkinson disease is a condition that causes problems with movement, mental health , sleep , pain and other health issue .Globally disability and death due to PD are rapidly increasing . PD one of the most frequently occurring neurodegenerative disease in people of middle and older age affects the integrity of visuomotor pathways due to degeneration of dopaminergic nigrostriatal projections .[1] In daily life, even simple visually guided motor behavior such as pressing a button requires a well functioning network of many subcortical and cortical regions , including the nigro striatal pathways. These areas form an integrated network that allows very precise visuomotor coordination of eye and hand movements[2]. Eye and hand movements share the internal representation of the goal and both require nigrostriatal connections. However the internal representation of the goal require nigrostriatal connections. However, the internal transformations and effector commands for eyes and hands are quite different [3] .As a result, eye movements may lead or lag the hand movement depending on the task. The relative timing parameters may already be disturbed at early stage of PD and provide behavioural marker for early diagnosis of PD.[4]The ability to continuously adopt motor commands to meet task demands is essential to successful interactions in dynamic environment. On- line corrections of hand movements to grasp a moving object require complex eye hand coordination .The brain must analyse visual input about the object and the environment and analyse proprioceptive input from the limb, head , eyes and update its representations in relation to dynamic changes of the environment and the arm precisely moves based on timed motor commands .Parieto- frontal circuits mediate reaching and grasping .The Posterior parietal cortex is critical for on line visuomotor control, particularly in response to perturbations either of a target to be reached for or an object to be grasped. Two deficits particularly implicated in PD are the inability to assemble complex motor actions that include multiple movement componenets and difficulty in producing accurate movements that are internally generated rather than visually guided. Basal ganglia circuits may also play a very important role . Differentiated, parallel and largely segregated cortical – subcortical reentrant circuits link specific cortical areas with their corresponding regions in the basal ganglia . Precise, differentiated function within and across these tophographically separated circuits may facilitate the integration of different brain regions needed for coordinated motor output. The integrity of these circuits may also be crucial for gating afferent input to cortical motor areas in context – sensitive manner and thus context – dependent adaptive control of movement . under conditions of dopamine depletion , fronto – basal ganglia circuits become pathologically synchronized and locked in at beta band frequency, potentially reducing the ability of circuits to appropriately update an on going action in response to environmental perturbation.[5] . Eye hand coordination may be defined as skillful , integrated use of eyes, arms , hands and fingers in fine , precision movements .It is a complex phenomenon which involves several actions .1) goal formulation or process of conceptualizing a future action . 2) planning or the organization of steps and elements needed to carry out an intenting action 3) carrying out movement or translation of an intention or plan into productive movement , monitoring and regulation of movement in order to modify and correct the trajectory. Flowers (1975, 1976) found that PD patients were unable to use internal references of spatial and temporal constraints in motor tasks to generate accurate movements based on anticipatory or feed forward control process. Support for these interpretations comes from observations where elimination of visual feedback impairs performance in PD patients more than it does in normal control subjects. Moreover , PD subjects fail to optimally modulate their motor output in relation to spatial constraints of motor task.individuals with PD would be less able to scale force parameters such as velocity and acceleration where accuracy constraints are imposed, suggesting that there may be force regulation impairement in this movement disorder [6]co- ordination or coordinated movement is the ability to execute smooth, accurate controlled motor responses. The ability to produce these motor response is a complex process dependent on fully intact neuromuscular system . Nowadays there are only fewer devices which can help in gaining eye hand coordination .[7] Coordination assessments provide physical therapists with information related to motor performance . They help in identifying the source of motor deficits .The lack of eye hand coordination is treated with laser attached visual biofeedback system.

The laser pointer is used for the purpose of intervention where it acts as a feedback system.

MATERIALS AND METHOD :

Approval for the study was obtained from the Institutional Ethical Committee of SVMCH RI . Study design is an observational study design and study sampling is purposive sampling technique .The subjects were screened and those fulfilling the inclusion criteria and exclusion criteria were involved. Inclusion criteria includes male parkinson disease patients of age group 60- 75 years , patients with intact visual and auditory sensation , patients with eye hand coordination score greater than 2, patients without any other neurological disorders, patients without balance disorders. Exclusion criteria includes Patients with age group less than 50 and those with neurological disorders, patients with lack of visual and auditory response . Pretest assessment was done using eye hand coordination test. 30 Subjects were analysed and only 10 subjects were included based on criteria .Participants were informed about the study and consent was taken. The treatment protocol was done as follows for the duration of six weeks. The posttest assessment was done using eye hand coordination test. The interpretation of the study was done on basis of pretest and posttest assessment .

METHOD OF INTERVENTION : The method of intervention

1.Initially patient is positioned and laser pointer is attached to forehead , also a laser pointer is given in the hand of the patient

2. The laser sensing module is attached on the wall and patient stands infront of the laser module

3. The laser module can be aligned in horizontal/ vertical and single alignment based on the patient level of progression

4. As the therapist instructs the patient, he should point towards the instructed laser module with help of forehead pointer or hand pointer .

5. Eye hand coordination is trained in various positions as per the patient level of progression

6. Example : if the therapist instruct the patient to point no 5 with forehead pointer, patient should point the no5 laser module with the forehead pointer / if the therapist instructs the patient to point no 11 laser module with hand pointer , he should point no 11 with hand pointer.

WEEK	POSITION	EXERCISE	FREQUENCY AND INTENSITY	DURATION
Week 1,2	Standing	Eye hand coordination exercise with laser module	2 sessions per day (10 sets per session)	45 minutes
Week 3,4	Standing on balance board with wall support	Eye hand coordination exercise with laser module	2 sessions per day (10 sets per session)	45 minutes
Week 5,6	Sit to stand	Eye hand coordination exercise with laser module	2 sessions per day (10 sets per session)	45 minutes

FINDINGS : After 6 weeks of intervention , eye hand coordination test was done .Based on pretest and post test analysis, it was found that application of laser pointer visual biofeedback is found to improve eye hand coordination in Parkinson disease patient .

TABLE 01: REPRESENTING PRETEST AND POSTTEST ANALYSIS OF EYE HAND COORDINATION

GROUP	MEAN		STANDARD DEVIATION		CALCULATED T VALUE	TABLE T VALUE	LEVEL OF SIGNIFICACE
A	PRE TEST	POST TEST	PRE TEST	POST TEST	5.96	2.306	<0.05
	3.44	1.78	0.73	0.67			

GRAPH 01: GRAPH REPRESENTING PRETEST AND POSTTEST VALUES OF EYE HAND COORDINATION
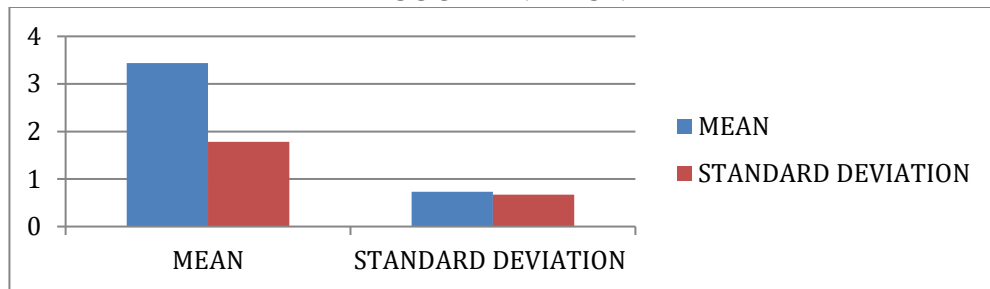
DISCUSSION :

Laser pointer biofeedback enables the patient to regain eye hand coordination .This works under the principle of neuroplasticity. Neuroplasticity refers to brain ability to reorganize itself by forming new neural connections in response to learning or injury. Laser pointer biofeedback training leverages neuroplasticity by repeatedly engaging visual and motor systems, encouraging brain to adopt and improve coordination .The laser pointer provides immediate visual cues, helping brain synchronize sensory input (visual tracking) with motor output. Repeated practice strengthens neural pathways responsible for eye – hand coordination , improving precision and reaction time. By connecting visual input (the laser dot) with motor output (neck and eye movement), it enhances the ability to integrate these two systems, a key component of eye-hand coordination. Laser biofeedback offers a unique approach by using the laser's dynamic movement for head and eye control, which can be a precursor to more complex hand-eye coordination tasks. The basic biofeedback paradigm suggests that whenever we provide a human being with feedback about a biological process, that feedback enables the individual to increase awareness of the process and gain conscious control. Physiotherapists uses biofeedback to help refine a movement sequence or activation pattern to assist patients to achieve a goal. This technique involves using visual, physical and/or auditory feedback to guide the patient to give their optimal performance. The ultimate purpose is that the patient gets to know his own body signs and that he can control them consciously in the first place using biofeedback equipment, afterwards even without. Furthermore, it is useful in that it helps the patient to reduce their reliance on the therapist and become more reliant on their own performance. The key to the success of biofeedback in rehabilitation is to use the device as an adjunct to therapy, to enable the patient to gain control without reliance on the therapist, and once gained, to maintain control without either the therapist or the machine.

CONCLUSION : The application of laser pointer visual biofeedback is found to improve eye hand coordination in Parkinson disease patients and the statistical analysis was also found to be statistically significant.

SOURCE OF FUNDING :

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