The Effect of Eye-Hand Coordination Device on Subjects with Hemiparesis

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Abstract

"Coordination" the harmonious functioning of interrelated organs and parts, applied especially to the process of the motor apparatus of the brain which provides for the co-working of particular groups of muscles for the performance of definite adaptive useful response. In Current Clinical Practises there Less Devices Which can help in Gaining Eye-Hand Coordination. Objectives: To compare the effect of conventional training approach and eye-hand coordination along with conventional training. Materials and Method: The subjects in Datta Meghe College Of Physiotherapy were screened and 42 subjects were divided into 2 groups i.e Group A subjects were given Conventional Physiotherapy for coordination training and Group Eye-Hand Coordination Device along with given Conventional Physiotherapy for coordination training. The interpretation of the study was done on the basis of comparing pre-test and post-test assessment of NCT grading and FMA-UE.

Result: Intragroup comparison results showed that NCT grading and FMA-UE scale were statistically significant in both the groups ($p<0.0001$). Whereas the intergroup comparison results showed that Eye-Hand Coordination The device along with Conventional physiotherapy was statistically significant in improving NCT score ($p=0.0021$) and FMA-UE score ($p=0.0001$) than only Conventional Physiotherapy alone for Eye-hand In-coordination Conclusion: The Eye-Hand Coordination Device was Significantly effective when Given With Conventional Physiotherapy For treating In-coordination and improvement in coordination. Conventional Physiotherapy is also effective in treating in-coordination, but after a certain duration of treatment, the patient starts getting adapted and chances of achieving the plateau phase

Keywords: *Eye-Hand Coordination Device, Hemiparesis, NCT Grading, FMA-UE.*

Introduction

Coordinationis the even operating of interrelated vital organs and parts, applied especially to the process of the motor mechanism of the brain which provides for the co-working of particular groups of muscles for the performance of definite adaptive useful response. There are several types of coordination observed in humans namely intralimb, interlimb & visual-motor. Intralimb coordination refers to movements occurring within a single limb (eg: alternately flexing or extending the elbow). Inter-limb (bimanual coordination) refers to the integrated performance of two or more limbs working together (ex: between limb movements of the lower extremities and/or upper extremities during walking). Visual - motor coordination is the ability to integrate both visual and motor abilities with respect to the external environment in order to achieve a goal.[2]

Eye hand coordination which is a sub category of visual motor coordination hasits own merits with regards

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to activities of daily living. It is also named as eye-hand-head coordination because movement of the head is typically required for the eyes to fixate on a target or object[3,4].

Incoordination isobserved in patients following a vascular insult in brain. It is suggested that the lack of coordinated voluntary movement observed in hemiparetic patients may be due to impaired regulation of spinal neurons.

The structure getting involved in the incoordination pathology is the cerebellum it receives information from the sensory systems, the spinal- cord, and other parts of the brain and then regulates motor movements. voluntary movements like posture, balance, coordination and speech leading to smooth and balanced muscular activity are all impaired if there's involvement of this structure[1]. Direct damage while not causing paralysis or intellectual impairment, might lead to lack of balance, slower movements & tremors[5]. Complex physical tasks and fine motor functions including prehension would become unsteady and halting[6]. Coordination impairments associated with dorsal column medial leminiscal (dcml) lesions are somewhat less characteristic than those produced by either the cerebellum or the basal ganglia pathology.

Biofeedback a specialized form of feedback that provides information directly to a patient about internal biological mechanisms via a somewhat sophisticated electronic device.it provides a feedback to individuals about their internal physiological events in order to state whether they are normal or abnormal and in case of abnormal to correct them respectively[7]. Biofeedback may be in the form of auditory, visual, tactile, gustatory and olfactory signals. In this research biofeedback is used to inform patient about movement and whether his activity is taking place in a coordinated manner. The instrument used in biofeedback process here is non-invasive and can be easily operated. The main goal of biofeedback here is to improve motor performance along with coordination through auditory signals and motor learning. Motor learning leading to control over the motor activities requires signalling from the external world as well as his own proprioception. hence biofeedback works best as a substitute for proprioception. Here the patient must aim in fulfilling 3 things in a progressive manner. Initially the focus should be on adapting and understanding the relationship of the electronic signal to achieve a desired task. After accomplishing this stage the individual should progress to practice controlling the feedback signals and after achieving this the task should be performed for several times until he has gained full control and coordination over it.

The learning pyramid also known as the cone of learning, experience, learning cone, the cone of retention,the pyramid of learning, or the pyramid of retention is a group of popular learning models and representations relating different degrees of retention induced from various type of learning.this pyramid of learning is a layer wise presentation represented in percentages[8]. It originated in 1954 in a book called audio-visual method in teaching. It was developed by the national training laboratories institute in the early 1960s, on its main campus in bethel, main. This model generally displays the following representation mentioned as below: out of which our feedback method provide audio-visual method, demonstration method and practice method. Therefore, the individual retention rates for audio-visual method is 20%, for demonstration is 30% & for practice is 75%. In this all the three method are combined and used in the rehabilitation process of the patient making the treatment more effective and showing better results in the prognosis of the patient.

Materials and Method

Approval for the study was obtained from the institutional Ethical Committee of the University. The subjects in Datta Meghe College of Physiotherapy and shalinitai Meghe hospital were screened and those fulfilling the inclusion and exclusion criteria were involved. Participants were informed about the study and consent was taken. Pre-test assessment was taken by using Non-Equilibrium Coordination Test, Non-Equilibrium Coordination Test Grading and FMA-UE to assess the patient. 42 subjects were divided into 2 groups, Group A and Group B based on the inclusion and exclusion criteria. The treatment was started the first day when the subject came for consultation. Group A subjects were given Conventional Physiotherapy and Group B subjects were given Eye-Hand Coordination Device Along with conventional Physiotherapy. The post-test assessment was taken by using NCT Grading and FMA-UE to assess the patient. The interpretation of the study was done on the basis of comparing pre-test and post-test assessment of Non-Equilibrium Coordination Test Grading and FMA-UE

Group A: Conventional Physiotherapy For improving Coordination

- Frenkels Exercises for upper extremities
- Ball throwing to specific target.
- Ball Juggling
- Small ball tosing
- Target practise
- Wall ball bounce
- Aiming Practise

Group B: Eye-Hand Coordination Device - Patient should be in sitting position, patient will be asked to hold the hand piece which is of diameter 5cm, 4cm, 3cm, 2cm and 1cm accordingly.

- First the therapist will demonstrate the activity.
- The patient will be handed the hand piece and ask to move the hand piece from starting position to ending position and then again reach the starting point without much shaking of hand piece and with steadiness
- If the patient touches the wire then a buzzer will be on and light will blow and that will a biofeedback that means that the patient has to go to the starting point again for
- For starting we have asked the patient to perform the procedure on a wire which will be a straight line which is the basic level.
- The levels will be made difficult by making the wire into many different shapes.
- Once the patient gains confidence that he can perform the procedure easily he can go to the next level.

Statistical Analysis: Statistical analysis was done manually and by using the statistics software's INSTAT so as to verify the results derived. The statistical analysis of non-parametric data was done by Wilcoxon matched pairs test and Man-Whitney test. Wilcoxon matched pairs test was used for statistical analysis of pre and post intervention within the group. Man-Whitney test will be used for between groups statistical analysis of Group A and Group B (pre-pre and post-post intervention).

Table 1. Distribution According to Side Wise in Stroke

	Stroke			
	RT. Hemiparesis	**LT. Hemiparesis**	**TIA**	**Dropout**
Group A	8	13	0	
Group B	7	7	1	6
Total	**15**	**20**	**1**	**6**

Table 2: Data of NCT

	Non-Equilibrium Coordination Test Grading				p valve (Pre-Post)	Inference
	Pre-test		Post-test			
	Mean	**SD**	**Mean**	**SD**		
Group A	1.571	0.8701	2.619	0.7400	<0.0001	Extremely significant
Group B	1.533	0.5164	3.200	0.4140	<0.0001	Extremely significant

Table 3 : Data of FMA (Total Score)

	FMA-UE				p value (Pre-Post)	Inference
	Pre-test		Post-test			
	Mean	**SD**	**Mean**	**SD**		
Group A	33.000	4.764	43.095	5.665	<0.0001	Extremely significant
Group B	34.333	6.114	50.600	5.938	<0.0001	Extremely significant
p value (Pre-Pre) and (Post-Post)	0.5340		0.0001			
Inference	Not Significant		Extremely Significant			

Discussion

Eye-hand coordination is central to so many human activities–the tool used eating, sports and work, to name few as to be defining characteristics of typical human life, conversely, its disruption following the stroke, disease, injury, and developmental disorder leads to considerable degeneration in productivity and quality of life. Naturally eye-hand coordination involves the synergistic function of various systems including visual, balance system proprioception and the eye heads and arm control systems, plus aspects of awareness- like attention and, memory[9,10,11]. Eye hand coordination plays vital role in ADL activities Eg-Eating, Drinking, Doing Writing Work, Passing any object to the surrounding Cleaning, Typing in laptop or typing machine. In the patients with neurological impairment neurological impaired subjects during Rehabilitation usually, eye-hand coordination mostly gets untreated. The objectives of this study were to find the effect of eye-hand coordination device on coordination in subjects with hemiplegia. To find the effect of eye hand coordination device along with conventional physiotherapy in improving eye-hand coordination. To compare the effect of Eye-hand coordination device and conventional physiotherapy in improving eye-hand coordination[12,13]. The study was conducted with 42 subjects. Subjects were divided into two groups. Eye-Hand Coordination device along with Conventional physiotherapy (Group A) and Conventional Physiotherapy (Group B). Prior consent was taken. The treatment protocol was carried out for 6 days per week for 5 weeks. The outcome measures for this study were Non-equilibrium coordination test grading and Fugl-Meyer Assessment-Upper Extremity scoring system[14,15]. The results of this study showed that there was a significant improvement in Coordination, improving quality of life and reducing rehabilitation time after 5 weeks of intervention in both the group A and group B in Subjects with incoordination. Wilcoxon matched pairs test was used to analyzethe effect eye-hand coordination device and showed that there was extremely significant improving coordination in NCT Grading score (0.0097) and FMT-UE (p=0.0001). Researches have proved that there is improvement hand pointing accuracy. A Study Done by B. Biguer C. PrablancM. Jeannerod showed that the accuracy of pointing motion of the hand, directed at visual acuity 10° to 40° from the center, was measured in normal subjects. No visual feedback from the moving hand was available to the participants. The face could be either maintained fixed (head-fixed condition) or free to move (head-free condition) during the pointing movements. It was found that the flaw in marking was reduced for all targets in the head-free condition. This reduction was more important for the more eccentric spot. Enhancement in precision was observed without any remarkable change in either the latency or the duration of eye, head or hand movements[16]. Another Study done by Halil Ibrahim Ceylan and Ozcan Saygin conducted a study on Examining the Effects of Proprioceptive Training on Coincidence Anticipation Timing, Reaction Time and Hand-Eye Coordination The study stated that the effects of proprioceptive training on coinciding anticipation timing (CAT), reaction time and hand-eye coordination. 42 volunteer students participated in the paper. These students were randomly divided into two groups as control and experimental groups. An exercise program was applied to the experiment and control groups for approximately 3 days in 8 weeks, for about 45 to 60 minutes. Additionally, a 20-minute modified proprioceptive balance program was applied to the experimental group only. Paired sample tests were used. As a result, significant differences were found in the performance, reaction time and hand-eye coordination performances of the experiment group, pretest, and posttest ($p<0,05$). Significant differences were found in dominant hand visual reaction time and hand-eye coordination performances of the control group, pretest, and posttest ($p<0,05$). In conclusion, it is seen that proprioceptive training affect CAT performance and reaction time performances in a positive way[17,18].

Conclusion

The present study provided evidence to support the use of eye –hand coordination device along with conventional physiotherapy in improving NCT and FMA-UE scores in Subjects with Hemiparesis. In addition, results supported that among Eye-hand coordination device and conventional physiotherapy were significantly effective in improving eye-hand coordination and improving the quality of life in subjects having affected eye hand coordination in hemiparesis.

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Conflict of Interest: Nil.

References

1. Rizzo J et al. Eye -Hand Re-Cordination: A Pilot Investigation of Gaze and Reach Biofeedback in Chronic Stroke. Progress in Brain Research. 2019; 249: 361-374,
2. Alwhaibi R et al. Effects of Auditovisual Feedback on Eye-Hand Coordination In Children With Cerebral Palsy. Research In Developmental Disabilities. 2020; 101: 103635,
3. Montano- Murillo R et al. Design & Assessment ofA Remote Vibrotactile Biofeedback System For Neuromotor Rehabilitation Using Active Markers. Prcedia Technology. 2013; 7, 96-102,
4. Vidoni, E et al. Manual & Occulomotor Performance Develop Spontaneously But Independently During Continuous Tracking. Experimental Brain Research. 195(4), 611-620.
5. Jenmalm P et al. Visual & Somatosensory Information about Shape Control Manipulative Finger Tip Forces. J Neurosci 17:4486-4499.
6. Thach W. A Role For the Cerebellum In Learning Movement Coordination. Neurobiology Of Learning And Memory. 1998; 70(1-2),177-188.
7. Diedrichsen J et al. Dissociating Timimg and Coordination As Functions Of Cerebellum. Journal Of Neuroscience. 2007; 27(23), 6291-6301.
8. Ramnani N et al. The Cerebellum And The Parietal Cortex Play A Specific Role In Coordination PET Study, Neuroimage. 2001; 14(4),899-911.
9. Brown S et al. Role Of Cerebellum In Visuomotor Coordination, Experimental Brain Research. 1993; 94(3),478-448.
10. Miall R et al. The Cerebellum Coordinates Eye and Hand Tracking Movements, Nature Neuroscience. 2001; 4(6),638-644.
11. Sheikh, M. The Effect of Eye-Hand Coordination Device on Coordination in Subjects with in-Coordination, Indian Journal of Public Health Research & Development. 2020; 11(1):202-206.
12. Dreher J, Grafman J. The Roles Of The Cerebellum & Basal Ganglia In Timing And Error Prediction. Eur J Neurosci. 2002; 16:1609-1619.
13. Ulta Bultmannet al. Functional Recovery & Rehabilitation of Postural Impairment & Gait In Patients With Acute Cerebellar Stroke, Gait Posture. 2014; 39(1), 563-569.
14. Flemming J et al. A Review Of Awareness Interventions In Brain Injury Rehabilitation, Neurophysiological Rehabilitation. 2006; 16 (4): 474-500.
15. Yanling J et al. Learning Pyramid Theory in the Application and Practice of Flipped Classroom, China Educational Technology. 2014; 7: 133-138,
16. Baer J. Lectures May Be More Effective Than You Think: The Learning Pyramid Unmasked,The International Journal Of Creativity & Problem Solving,2010; 20(2):7-21.
17. Talbot M et al. The Effects of Auditorally Augmented Feedback onthe Eye-Hand Coordination Of Students With Cerebral Palsy, American Journal Of Occupational Therapy. 1981; 35(8), 525-528.
18. Hore J et al. cerebellar dysmetria at the elbow wrist and finger journal of neurophysiology, 1991; 65(3): 563-571,