Ann. For. Res. 65(1): 4076-4082, 2022
ISSN: 18448135, 20652445
ANNALS OF FOREST RESEARCH
https://www.e-afr.org/

EFFECTIVENESS OF AUGMENTED REALITY IN IMPROVING GAIT AND QUALITY OF LIFE IN STROKE SUBJECTS

M. Pradeepa*[1], Dr.P. Senthil Selvam[2], R. Nandakumar[3], C.K. Muralidharan[4], Dr. C. Sivakumar[5].

[1]Research Scholar, School of Physiotherapy, Vels institute of science Technology & Advanced Studies (VISTAS), Chennai – 600130, Tamilnadu, India.

[2]Head of department, School of Physiotherapy, Vels institute of science Technology & Advanced Studies (VISTAS), Chennai – 600130, Tamilnadu, India.

[3]Research Scholar, Madhav University, Sirohi - 307001, Rajasthan, India.

[4]Professor, Nandha College of Physiotherapy, Erode - 638052, India.

[5]Principal, PPG College of Physiotherapy, Coimbatore - 641035, Tamilnadu, India.

ABSTRACT:

BACKGROUND: Rehabilitation of stroke afflicted patients, through exercises tailored for individual needs, rehabilitation through augmented reality based games engage and motivate patients to perform exercise. **METHODS:** 20 subjects were selected using simple random sampling method. Group A (n=10) received Augmented reality along with task-oriented training and Group B (n=10) received task-oriented training. The total duration of the study was about three months and treatment duration were 6 weeks. **RESULTS:** Pre and post-test values of gait and quality of life was measured using TUG, DGI and SSQL In statistical analysis pre-pre comparison was not significant however post-post comparison was statistically significant with paired sample t test value of 2.262 and unpaired sample t test value of 2.101 with level of significance set at $p<0.05$. **CONCLUSION:** Thus, the result indicates that augmented reality training has significant effect on improving gait and quality of life when compared to task-oriented training. Therefore, ART may be beneficial in increasing the gait and quality of life among stroke subjects.

KEYWORDS: Stroke subjects, Augment Reality Training, task-oriented training, Dynamic Gait Index, Timed Up and Go, Quality of life.

INTRODUCTION:

Stroke is one of the devastating medical occurrences worldwide(1). Stroke is also one of the most common cause of disability leading to poor quality of life(2). The burden of stroke is increasing in India now, becoming the fourth leading cause of death and fifth leading cause of disability. Crude incidence of stroke ranged from 108 to 172/100,000 people per year, crude prevalence from 26 to 757/100,000 people per year, one-month case fatality rates from 18% to 42%(3).

Three quarters of stroke occurs in the region supplied by middle cerebral artery, as a consequence the upper limb is affected, in large number of patients. The Middle Cerebral Artery [MCA] is the second of the two main branches of the internal carotid artery and supplies the entire lateral aspect of the cerebral hemisphere (frontal, temporal and parietal lobes) and sub cortical structures, including the internal capsule (posterior portion), Corona

Radiata, Globus Pallidus (outer part), most of the caudate nucleus and putamen. Middle Cerebral artery occlusion is more common site of occlusion in ischemic stroke. Clinical manifestation of MCA syndrome was contralateral hemi paresis, contra lateral hemi sensory loss. Occlusion of the proximal MCA produces extensive neurological damage with significant cerebral edema(4,5,6) leading to symptoms of motor and receptive speech impairment, non-fluent speech with poor comprehension, perceptual problems- unilateral neglect and apraxia and Lacunar stroke (pure motor). Hemiparesis is one of the most pervasive and disabling impairment in which recovery of arm function is poor in significant number of patients and leg function has proven to be a less problem Sensory motor function involves the process of receiving sensory messages, afferent (sensory input) and producing a response efferent (motor output). Gait and balance disturbance are more prone in stroke patient inspite of branches of blood vessels involved. These are major problems for stroke patients to face(7). Human ambulation, or, gait, is one of the basic components of independent function commonly affected by stroke(8). More than 85% of these patient experience hemiplegia immediately after stroke gait disorders in patients with stroke cause restrictions in daily living activities(9). Motor learning research has revealed some important concepts to optimizing rehabilitation such as external focus attention, implicit learning, variable practice, training intensity, task specificity, and feedback on performance(10). This type of training can be achieved fully with a help of modern advancement. The improvement of motor movement through visual memory game in the rehabilitation programs is an emerging approach that comes from technological development. A system providing combined training in virtual and physical environment is referred to as augmented reality (AR) training environment. Lower limb rehabilitation protocols with AR have generally not included an assistive device. Use of AR technology is to characterize postural balance and assess patients' progress(11) or supply visual aid to mirror patient's action. The use of Augmented reality provided active assistance as well as characterizing the user's kinematics for real life-time feedback. That proves the intuitive feedback. Augment reality training act in motor learning principle and sensorial environment of individual by mediating reality through technology(12). Task oriented training (TOT) provides beneficial neuroplasticity effect after stroke. It is used to facilitate functional movement. The training involves skills and endurance. (13) TOT is based on Carr and Sheperd's motor learning theory.

METHODS AND MATERIALS: This is an experimental study which was conducted at the Ashwin Multispecialty Hospital, Coimbatore. 20 subjects were selected using simple random sampling method. The inclusion criterion includes Sub acute MCA stroke subjects with 24 points on Mini Mental Scale, Brunnstrom stages IV and V, FAC -1 to 3 (Ability to walk 10 m distances with/without assistance) between the age group of 40 to 65 years. The study excluded subjects with Pusher syndrome, Cognitive impairment patients, Aparxic and Hemineglect, Visual and Vestibular impairment, other neurological disorders. The procedure and techniques were clearly explained to the subjects and written inform consent was obtained prior to the start of study. Group A (n=10) received Augmented reality training and Group B (n=10) received task-oriented training. The treatment duration was 60 minutes per day, 5 days per week for 6 weeks for both the groups.

The study was conducted for about 3 months. Pre-test and post-test values of gait were measured by TUG and DGI. Quality of life measured by SSQL was taken before and after the intervention.

PROTOCOL: Group A received usual physiotherapy exercises for 30 minutes. They were: Trunk exercises, Lower limb exercises, Upper limb exercises, Ocular exercises. Augmented reality training for 30 minutes. There were includes: Football kick, Champion football league, Pokemon go.

Group B task-oriented training for 60 minutes. They were: Trunk exercises, lower limb exercises, standing up sitting down on the chair, step up, balance beam, kicking a ball, speed walk, walk backward, stair, walk and carry. Each item was done for about 5 minutes including 15 sec rest between them.

DATA COLLECTION: Data was statically analyzed using a paired samples ‘t’ test within groups and unpaired samples ‘t’ test was used for within groups. The level of the statistical significance was set at $p<0.05$. The augmented reality training was significantly higher compared to following a conventional group intervention.

TABLE 1 Comparison of values within group analyses of group A and group B in pre and post test

DGI	PRE TEST		POST TEST		t TEST	Df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
Group A	17	1.1	21	0.8	22.6	9	< 0.05
Group B	17	1.5	20	1.1	16.30	9	

TUG	PRE TEST		POST TEST		t TEST	Df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
Group A	12.60	0.65	10.85	0.33	9.93	9	< 0.05
Group B	12.40	0.96	7.90	0.57	10.62	9	

SSQL	PRE TEST		POST TEST		t TEST	Df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
Group A	118.3	2.4	206	4.7	115	9	< 0.05
Group B	119	2.3	180.1	2.9	44.9	9	

Above the table reveals the mean, and standard deviation (S.D), t test, degrees of freedom (df), and p value of the SSQL, DGI, TUG in between the group A and group B.

TABLE 2 Comparison of values between group analyses of group A and group B pre-pre and post-post values.

DGI	GROUP A		GROUP B		t TEST	Df	SIGNIFICANCE
	MEAN	S. D	MEAN	S. D			
Pre test	17	1.1	17	1.5	0.46	18	>0.05
Post test	21	0.8	20	1.1	3.05	18	<0.05

TUG	GROUP A		GROUP B		t TEST	Df	SIGNIFICANCE
	MEAN	S. D	MEAN	S. D			
Pre test	12.60	0.65	12.40	0.96	0.42	18	> 0.05
Post test	10.85	0.33	7.90	0.57	10.02	18	<0.05

SSQL	GROUP A		GROUP B		t TEST	Df	SIGNIFICANCE
	MEAN	S. D	MEAN	S. D			
Pre test	118.3	2.4	119	2.3	0.1	18	> 0.05
Post test	206	4.7	180.1	2.9	27.50	18	<0.05

Above the table reveals the mean, and standard deviation (S.D), t test, degrees of freedom (df), and p value of the SSQL, DGI, TUG in within the group A and group B.

Result:

The pre-test and post-test statically analyzed so that there was significant difference in between within group (paired t test) at 5% level of significant for 9 degree of freedom and between group (unpaired t test) analyses at 5% level of significant for 18 degrees of freedom. In paired t test obtained results was greater than observed calculated probability (2.262), in unpaired t test pre-pre comparison were not significant (> calculated probability: 2.101), however post-post comparison results shown that there were significantly improvement in gait and quality of life among stroke patients (< calculated probability: 2.101), There is an improvement in both groups, eventually Group A have more significant improvement than Group B. Hence, null hypothesis is rejected.

Figure 1

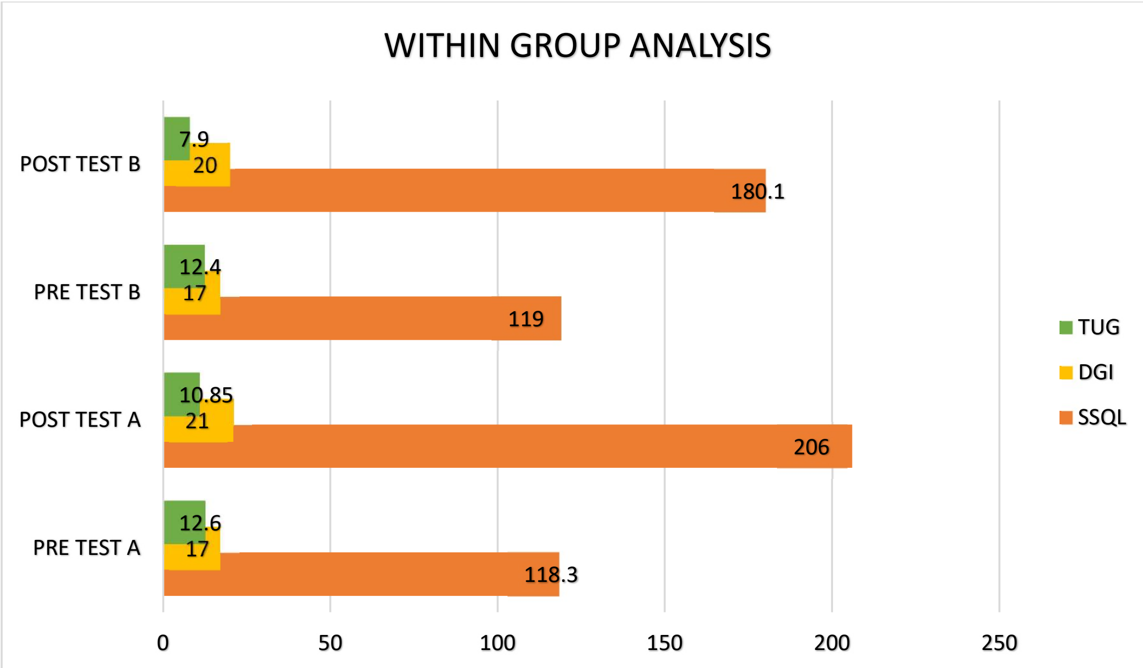

Figure 2

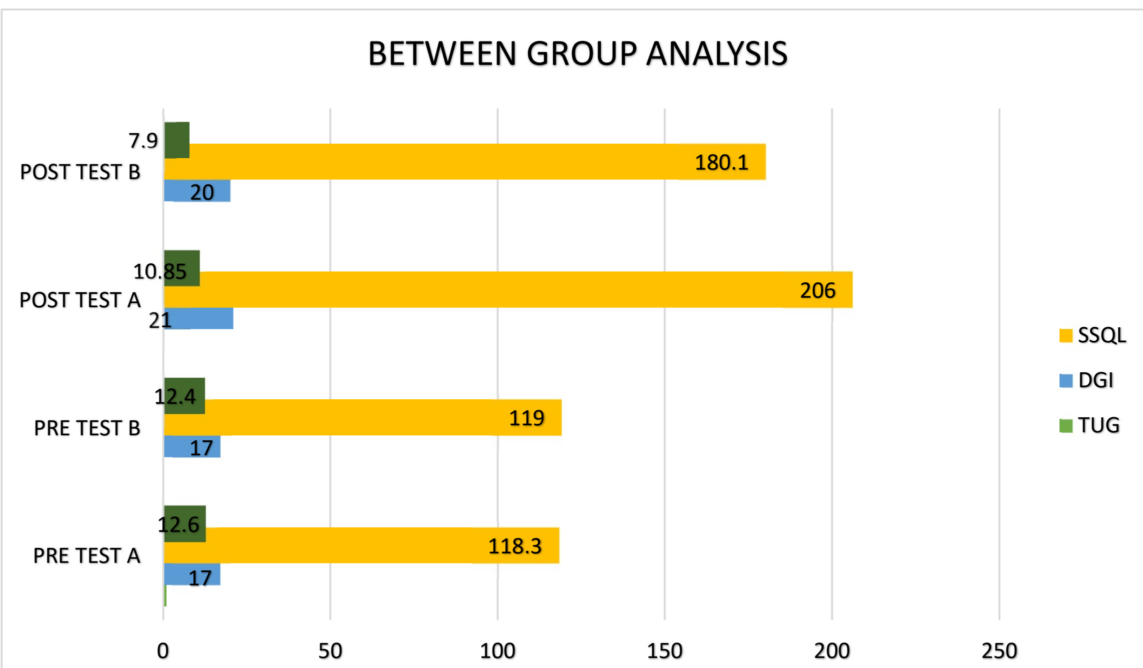

Figure 1 and 2 shows mean difference of group A and B - SSQL, DGI, TUG

DISCUSSION AND CONCLUSION:

AR training utilizes the virtual objects to accelerate the present physical environment. Thereby, maintaining the sense of presence in the real-world environment. This activates the visuospatial network of the brain. Interactive virtual environments can also augment postural control by stimulating the sensory processes responsible for maintaining balance and orientation. Virtual augmented environments also can specifically target motor learning by selectively activating the motor areas of the brain. Thus, after thirty sessions of Augmented training for about 6 weeks subjects showed significant improvements in quality of life and gait on SSQL, TUG and DGI. Individual's performance, success rate and response time of each exercise also improved steadily across each session when compared to conventional group subjects.

Conclusion: The present study concluded that AR training across 30 sessions (30 min/session) over a 6-week period is a safe, well-tolerated, and efficacious method of improving gait and quality of life in stroke subjects when compared to conventional physiotherapy

Limitations: In the present study, our training period was relatively short, and the sample size was small. Further trials that examine the usefulness of the ARS in a large study with long-term training program are required to compare this approach with conventional therapy in improving gait training and quality of life.

ACKNOWLEDGEMENT: The author would like to acknowledge all the participated in the study. I would like to extend my thanks all staff and friends who had helped me to complete the study.

REFERENCES:

1. Bindu shajan perappadian. (2019 July 14). Contribution of non-communicable neurological disorder and neurological injuries to the total diseases burden has more than doubled between 1990 and 2019. *The Hindu.* R. L. Sacco, S. E. Kasner, J. P. Broderick et al. (2013). "An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American heart association/American stroke association," *Stroke*, *44*(7), 2064–2089.
2. Huu Lam Phan, (2022). Effective ness of augmented reality in stroke rehabilitation: A Mata-Analysis. *Appl. Sci. 12,* 1848.
3. Pawan T Ojha, et al. (2020). Incidence of stroke in adults according to age, sex and subtypes in urban Indian population. *Neurol Neurosci Rep. 3*: 1-4.
4. Chiara Arienti, et al. Rehabilitation *interventions* for improving balance following stroke: An overview of systematic reviews. *PLoS ONE*; 2019. *14*(7): e0219781.
5. Janice J Eng, et al. Gait training strategies to optimize walking ability in people with stroke: A synthesis of the evidence. *Expert Rev Neurother7*; 2017. (10): 1417-1436.

6. Newman AB, et al. Association of long-distance corridor walk permenant with motality, cardiovascular diseases, mobility limitation, and disability. *JAMA*; 2006. *295*(17): 2018-2026.
7. Jorgensen HS, Nakayama H, Raaschou HO, Olsen TS. Recovery of walking function in stroke patients: the Copenhagen Stroke Study. *Arch Phys Med Rehabil*; 1995. *76*: 27–32.
8. Juhyung Park, and Chanuk yoo. (2015). Effects of task-oriented training on upper extremity function and performance of daily activities by chronic stroke patients. *J. Phys. Ther. Sci. 27:* 2657-2659.
9. Jorgensen HS, Nakayama H, Raaschou HO, Olsen TS. (1995). Recovery of walking function in stroke patients: the Copenhagen Stroke Study. *Arch Phys Med Rehabil*, *76*: 27–32.
10. Selma Papegaajii et al. (February 2017) virtual and augmented reality-based balance and gait training. Motek a DIN brand.
11. Jeonghun ku, et al. (2018). Three-dimensional augmented reality system for balance and mobility rahablilitation in the elderly: A randomized controlled trail.
12. Enrico Gandolfi. Virtual reality and augmented reality. Hand book of reasarch on k-12 online and blensind lrearning (second edition). 39th chapter: 545-561
13. Annick A. A. et al. (2010). Influence of task-oriented training content on skilled arm-hand performance in stroke: A systematic review. *Neurorehabilitation and neural repair 24*(9): 858-870