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Visual imagery versus auditory imagery on upper extremity function in subjects with chronic stroke

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Abstract
Background: Up to 85% of post-stroke survivors experience upper limb weakness and even after therapeutic interventions, only 20% to 56% of them regain complete functional use of the paretic upper limb. Hence it is important to improve upper limb function and reduce long term disability.
Objectives: To compare the effect of Visual Imagery versus Auditory Imagery on upper extremity function in chronic stroke subjects.
Materials and methods: 30 stroke subjects were recruited and were allotted into two groups randomly. Group A received Visual Imagery Training along with conventional therapy. Group B received Auditory Imagery Training with conventional therapy. The treatment sessions were scheduled for 30 minutes per day, 4 times per week, for 4 weeks. Upper extremity function was assessed prior to and post-intervention using Fugl-Meyer Assessment for Upper Extremity (FMA-UE).
Results: The pre-test scores of FMA-UE were 28.80±8.24 in Group A and 33.62±9.61 in Group B. The post-test scores of FMA-UE were 40.33±11.39 in Group A and 41.20±11.73 in Group B. When the post-test scores between the groups was compared, there was no statistically significant difference ($p > 0.05$).
Conclusion: Results of the study show that upper extremity function significantly improved individually in both the groups, but no statistical significant difference was seen in between the groups. The study concluded that both the interventions are equally effective in improving the upper extremity function in chronic stroke subjects.

Keywords: Chronic stroke, visual imagery, auditory imagery, upper extremity function

Introduction
Stroke is the sudden loss of neurological function caused by interruption of the blood flow to the brain. It is one of the major causes for physical and functional disability in adult population globally [1]. Incidence of stroke has risen in low and middle income countries [2].
After stroke, upper extremity weakness is seen both in acute as well as chronic stages of recovery, with up to 40% of the individuals never improving on the functional use of the extremity during daily activities. Upper extremity impairments after stroke are well documented which include tonal abnormalities, muscle tightness and contractures, reduction in strength and dexterity, reduced active joint range of motion, and reduced movement speed, bimanual coordination and precision [3]. Post-stroke, functional recovery of the upper extremity continues to be one of the greatest challenges in rehabilitation. Alternative strategies are required to lower long-term disability and functional impairments that are caused by stroke [4]. Functional independence and quality of life is affected in 50–70% of all stroke patients with upper extremity impairment [5].
The goal of neurologic rehabilitation is to minimize impairments and disabilities so that individuals who have had a significant stroke can resume self-care and everyday activities as independently as possible. New metholodologies and recent discoveries regarding how the central nervous system reacts to injury and how patients retrain lost behaviours by training have resulted in potential new neurorehabilitation techniques. Mental imagery or motor imagery is one among them and the ongoing research might amount to an impending paradigm shift in this field [6].
Motor imagery is the mental depiction of movement without actual body movement. There has been a lot of research published on the beneficial effects of practicing motor imagery on motor performance and learning in athletes, healthy individuals and people with neurological problems [7].

Motor imagery is cost effective, reliable and if the subjects are trained properly, they can do it by themselves without any assistance or equipment. The appeal of motor imagery as a potentially effective neuro-rehabilitation technique is popular, which is reflected in multiple reviews. Subjects with severe disability can successfully utilize motor imagery as the same cortical areas of the brain are activated as for motor execution. There are various studies that have proven the effectiveness of motor imagery using video tapes and audio tapes individually. But, there is a dearth of literature as unto which type of motor imagery is more effective. Hence, the aim of this study is to compare the effect of visual and auditory imagery on upper extremity function in subjects with chronic stroke.

Materials and Methods

Participants

30 participants with chronic stroke between the age of 40-60 years, male and female were recruited for the study. Subjects were included in the study if their Brunnstorm stage of motor recovery was between 5 to 7 [8], MMSE score was ≥24 [9]. Exclusion criteria included coexisting upper limb musculoskeletal or neurological conditions other than stroke, visual, somatosensory or auditory impairments and uncooperative subjects. Informed written consent was taken from all the subjects prior to the study and Institutional Ethical Committee clearance was obtained. Prior to the intervention, the upper extremity function was assessed using Fugl-Meyer Assessment of Upper Extremity (FMA-UE). FMA-UE has been studied for its reliability and validity for usage in subjects with chronic stroke [10, 11, 12].

Implementation of intervention:

30 subjects were randomly assigned into Group A and Group B, 15 in each group. Demographic variables such as age, gender, dominance and side of affection were documented. Both the groups were explained about the five functional tasks of upper extremity that they need to practice during the treatment. The functional tasks are bringing the hand to the mouth, turning the pages of a book, opening up elastic band that is placed around the fingers and thumb, picking up buttons and dropping them into a saucer, brushing or combing hair. For each of the sessions, the subjects sat on a chair comfortably with the hips, knees and ankles at 90 degrees, with the head held directly over the pelvis with an erect spine. The forearms were resting on the table without elevation or depression of the shoulder girdle.

Group A underwent Visual Imagery training as follows: The first step involved relaxation of the subjects as instructed by the therapist, 2 minutes of deep breathing exercises, followed by 3 minutes of progressive muscular relaxation. In the second step, the subjects were made to watch a video tape of the above mentioned 5 functional tasks of upper extremity at a normal speed performed by a normal individual, which they are supposed to imagine. In the third step, the subjects were instructed to perform the functional tasks with the non-paretic UE. In the fourth step, the subjects were asked to imagine the same functional tasks on the paretic UE while watching the video and try to analyze the problems they have with the affected side compared to the normal side. In the final step, the subjects mentally rehearsed the tasks with the paretic UE for three repetitions and correct them without actually performing them. The session concluded with the individuals being given time to refocus on the room they were in [13].

Group B underwent Auditory Imagery training program which was as follows: The first step involved relaxation of the subject as instructed by the therapist, 2 minutes of deep breathing exercises, followed by 3 minutes of progressive muscular relaxation. In the second step, the subjects were made to listen to an audio tape of the same functional tasks of upper extremity as mentioned, which they are supposed to imagine. In the third step, the subjects were instructed to perform the functional tasks with the non-paretic upper extremity. In the fourth step, the subjects were asked to imagine the same functional tasks on the paretic upper extremity while listening to the audio and try to analyze the problems they have with the affected side compared to the normal side [14]. In the final step, the subjects mentally rehearsed the tasks with the paretic UE, correct them without actually performing them. The session concluded with the individuals being given time to refocus on the room they were in [15].

The treatment session lasted for 30 minutes per session, 4 times a week and for 4 weeks for both the groups. Apart from this, both the groups received conventional physiotherapy for another 15 minutes which consisted of stretching, strengthening and ROM exercises for the lower extremities.

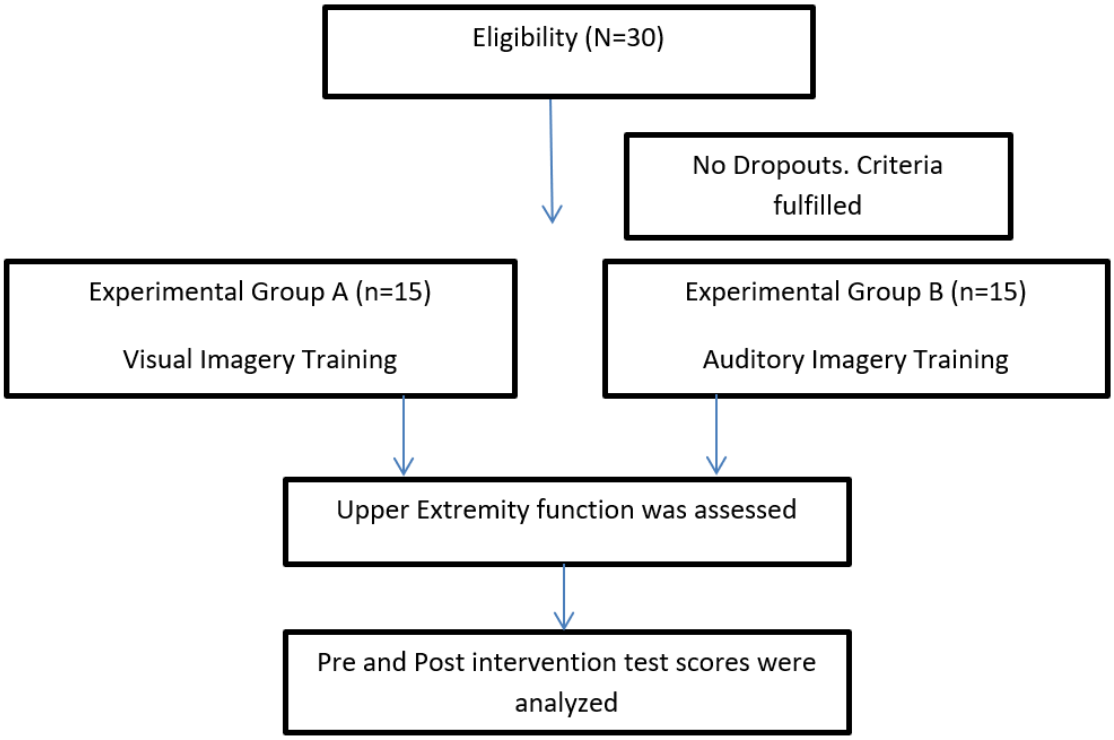

Fig 1: Consort Flow Diagram

Results

Table 1: The distribution of the subjects with chronic stroke according to their age, gender, duration of stroke, Brunnstrom stage of motor recovery, side affected and type of stroke.

S. No.	Variable	Group A	Group B
1	Age in Years	46.73±4.35	49.60±6.56
2	Male / Female	13(86.7%) / 2(13.3%)	13(86.7%) / 2(13.3%)
3	Duration of Stroke in Months	28.00±19.83	32.00±23.42
4	Brunnstrom Stage of Motor Recovery - 5 / 6	12(80%) / 3(20%)	11(73.3%) / 4(26.7%)
5	Side Affected - Left / Right	9(60%) / 6(40%)	8(53.3%) / 7(46.7%)
6	Type of Stroke - Ishaemic/Haemorrhagic	12(80.0%) / 3(20.0%)	11(73.3%) / 4(26.7%)

Table 2: Range, mean and SD of outcome measures of subjects with chronic stroke in Group A.

S. No.	Outcome measures	Group A				Wilcoxon test	p-value
		Pre test		Post test			
		Range	Mean ±SD	Range	Mean ±SD		
1	**FMA-UE**	19-41	28.80±8.24	19-59	40.33±11.39	z=3.308*	p<0.001

Note: * denotes –Significant (p<0.05)

Table 3: Range, mean and SD of outcome measures of subjects with chronic stroke in Group B.

S. No.	Outcome measures	Group B				Wilcoxon test	p-value
		Pre test		Post test			
		Range	Mean ±SD	Range	Mean ±SD		
1	**FMA-UE**	19-46	33.62±9.61	22-57	41.20±11.73	z=3.125*	p<0.001

Note: * denotes –Significant (p<0.05)

Table 4: Mean and SD of pre and post-test outcome measure of subjects with chronic stroke in between the groups

S. No	Outcome measures	Pre test		Post test	
		Group A	Group B	Group A	Group B
		Mean±SD	Mean±SD	Mean±SD	Mean±SD
1	**FMA-UE**	28.80±8.24	33.62±9.61	40.33±11.39	41.20±11.73
Between Group comparison Mann-Whitney U test		• FMA: z=1.291, *p*> 0.05, NS		• FMA: z=0.332, *p*> 0.05, NS	

S - Significant (p<0.05); NS - Not Significant (*p*> 0.05)

Discussion

The aim of the present study was to compare the effect of Visual Imagery and Auditory Imagery on upper extremity function in chronic stroke subjects. 30 subjects were randomly allotted to two groups. Demographic data such as age, gender, duration of stroke, Brunnstrom stage of motor

recovery, side affected and type of stroke were noted and the participants in both the groups were homogenous.

Participants in Group A received Visual Imagery training and compared to pre-intervention, post-intervention upper extremity function improved significantly ($p<0.001$). Cortical motor areas were seen to get activated with passive observation of movement. Post-stroke motor recovery can be contributed to redistribution of activity within a network of multiple parallel-acting cortical motor areas and reinforcement of the motor areas spared adjacent to the lesion [16]. It is important to develop effective exercise protocols based on neural plasticity and visual feedback to improve and facilitate the paretic hand movements which can restore functional performance and independence of chronic stroke individuals [17]. It was seen that timing was important to enhance mental practice, which emphasizes normal speed of the movement while using mirrors and videos during training [16].

Participants in Group B received Auditory Imagery training. Post-intervention, upper extremity function as seen in the FMA-UE scores improved significantly compared to pre-intervention scores ($p<0.001$). Literature evidence shows that muscle activity can be improved by auditory stimulation and practice using a rhythmic pattern. Motor planning and auditory feedback are closely associated and influence timing of motor skills, performance, reaction time and response quality. Several studies carried out in a clinical setting have recognized the importance of auditory stimulation in enhancing functional rehabilitation of individuals with hemiparesis [18]. It was observed that mental practice using audio tapes helped in activating the neuromuscular structures similar to physical practice. Some researchers observed use-dependent cortical reorganization and reduced non-use of the affected limb leading to functional improvement [19].

The pre-intervention scores of FMA-UE, when compared in between the groups were not significant statistically ($p> 0.05$) which shows the homogeneity of the subjects in between the groups. Results of this study showed that the post-intervention scores of FMA-UE in between the groups were statistically not significant ($p> 0.05$). Familiarity of the motor task is a prerequisite for motor imagery practice.[7] The results could have been influenced by the similarity in the visual and auditory training given. Mental imagery training is designed based on the physical, environmental and emotional components, tasks imagined and timing of the movement [20]. In this study, functional tasks the subjects in both groups were asked to imagine, were similar which could have led to improvement in both groups and hence there was no difference between the groups.

There were also a few limitations in the study. Small sample size was a major limitation that reduces the generalizability of the results to the entire population. Long term follow up of the subjects was not possible to see if the achieved results were retained even after a few months. The awareness regarding motor imagery was considerably less which was a challenge to convince the subjects concerned to participate and adhere to the treatment protocol. Vividness of imagery could not be assessed. Hand dominance was not considered. It is recommended that future research can be carried out on using these interventions on other neurological conditions. The study concluded that both the approaches are equally effective to improve upper extremity function in chronic stroke subjects and is recommended to use them in post-stroke rehabilitation.

Conflict of Interest: NIL

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References

1. BO'Sullivan S, Schmitz TJ, Fulk GD. Physical Rehabilitation. Davis Company. 2014.
2. Kamalakannan S, Gudlavalleti AS, Gudlavalleti VS, Goenka S, Kuper H. Incidence & prevalence of stroke in India: A systematic review. The Indian journal of medical research. 2017 Aug;146(2):175.
3. Faria-Fortini I, Michaelsen SM, Cassiano JG, Teixeira-Salmela LF. Upper extremity function in stroke subjects: relationships between the international classification of functioning, disability, and health domains. Journal of Hand Therapy. 2011 Jul 1;24(3):257-65.
4. Rajesh T. Effects of motor imagery on upper extremity functional task performance and quality of life among stroke survivors. Disability, CBR & Inclusive Development. 2015 May 9;26(1):109-24.
5. Hatem SM, Saussez G, Della Faille M, Prist V, Zhang X, Dispa D, Bleyenheuft Y. Rehabilitation of motor function after stroke: a multiple systematic review focused on techniques to stimulate upper extremity recovery. Frontiers in human neuroscience. 2016 Sep 13;10:442.
6. Taub E, Uswatte G, Elbert T. New treatments in neurorehabiliation founded on basic research. Nature Reviews Neuroscience. 2002 Mar;3(3):228-36.
7. Dickstein R, Deutsch JE. Motor imagery in physical therapist practice. Physical therapy. 2007 Jul 1;87(7):942-53.
8. Naghdi S, Ansari NN, Mansouri K, Hasson S. A neurophysiological and clinical study of Brunnstrom recovery stages in the upper limb following stroke. Brain injury. 2010 Oct 1;24(11):1372-8.
9. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. Journal of psychiatric research. 1975 Nov 1;12(3):189-98.
10. Murphy MA, Resteghini C, Feys P, Lamers I. An overview of systematic reviews on upper extremity outcome measures after stroke. BMC neurology. 2015 Dec;15(1):1-5.
11. Maki T, Quagliato EM, Cacho EW, Paz LP, Nascimento NH, Inoue MM, Viana MA. Reliability study on the application of the Fugl-Meyer scale in Brazil. Brazilian Journal of Physical Therapy. 2006;10(2):177-83.
12. Rabadi MH, Rabadi FM. Comparison of the action research arm test and the Fugl-Meyer assessment as measures of upper-extremity motor weakness after stroke. Archives of physical medicine and rehabilitation. 2006 Jul 1;87(7):962-6.
13. Lee J, Ahn S. Effects of sit-to-stand imagery group training on balance performance in individuals with chronic hemiparetic stroke: a randomized control trial. Physical therapy rehabilitation science. 2016;5(2):63-9.
14. Bovend'Eerdt TJ, Dawes H, Sackley C, Wade DT. Practical research-based guidance for motor imagery

practice in neurorehabilitation. Disability and Rehabilitation. 2012 Dec 1;34(25):2192-200.
15. Page SJ, Levine P, Sisto SA, Johnston MV. Mental practice combined with physical practice for upper-limb motor deficit in subacute stroke. Physical therapy. 2001 Aug 1;81(8):1455-62.
16. Letswaart M, Johnston M, Dijkerman HC, Joice S, Scott CL, MacWalter RS, Hamilton SJ. Mental practice with motor imagery in stroke recovery: randomized controlled trial of efficacy. Brain. 2011 May 1;134(5):1373-86.
17. Lin CH, Chou LW, Luo HJ, Tsai PY, Lieu FK, Chiang SL, Sung WH. Effects of computer-aided interlimb force coupling training on paretic hand and arm motor control following chronic stroke: a randomized controlled trial. 2015 Jul 20;10(7):e0131048.
18. Kim JS, Oh DW, Kim SY, Choi JD. Visual and kinesthetic locomotor imagery training integrated with auditory step rhythm for walking performance of patients with chronic stroke. Clinical rehabilitation. 2011 Feb;25(2):134-45.
19. Page SJ, Levine P, Leonard AC. Effects of mental practice on affected limb use and function in chronic stroke. Archives of physical medicine and rehabilitation. 2005 Mar 1;86(3):399-402.
20. Schuster C, Hilfiker R, Amft O, Scheidhauer A, Andrews B, Butler J, Kischka U, Ettlin T. Best practice for motor imagery: a systematic literature review on motor imagery training elements in five different disciplines. BMC medicine. 2011 Dec;9(1):1-35.