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RESEARCH ARTICLE

RECENT ADVANCEMENT TO IMPROVE BALANCE IN STROKE REHABILITATION.

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Abstract

After stroke, a main goal of rehabilitation is promote independent in activity of daily living. An important determinant of activities of daily living performance is standing and balance, which is a strong predictor of functional recovery and walking capacity in post stroke rehabilitation. Purpose of this study was to investigate the effects of different balance Techniques/Approaches on post stroke rehabilitation. Furthermore, the study was aimed to identify which training regimen was most effective. Electronic databases were searched to evaluate the effects of exercise therapy on balance capacity in stroke rehabilitation. 63 articles were studied and 42 were selected after inclusion and exclusion criteria strategies. After going through all the articles, it was concluded that both the three approaches (Mental Practice/Mental Imagery MP/MI, Visual Reality VR, and Mirror Therapy MT) were effective, but MP/MI is more effective according to my studies, it was observed that mental imagery is a safe and low-cost technique that can be performed even without supervision once the patient has completed appropriate training.

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Introduction:-

Stroke also known as Cerebrovascular accident (CVA) is defined as a clinical syndrome characterized by rapid developing signs of focal or global disturbance of cerebral functions, lasting for more than 24 hr or leading to death, with no apparent causes other than vascular origin. It is the leading cause of long term disability in adults [Mohan et al., 2013]. Residual motor weakness, abnormal movement synergies and spasticity often predispose the stroke survivor to a sedentary life style, which further limits the individual's activities of daily living and reduces cardiovascular reserves. These primary neurological deficits also result in altered gait patterns and contribute to poor balance, risk for falls and increased energy expenditure during walking. Efforts to minimize the impact and to improve functional outcomes after a stroke thus, pose an important challenge for rehabilitation professionals.

Balance and coordination impairments are common complications post-stroke, these deficits impede individuals abilities to participate in activities of daily living and reintegrate to participate in activities of daily living and reintegrate back into the community [Kong and Lee, 2014]. Maintaining one's balance requires continuous and simultaneous data processing from multiple systems (e.g. vestibular, visual, proprioception, and cognitive reintegration). When these systems have been impacted by a neurological injury, such as stroke, balance and balance-contingent activities (i.e. ambulation or maintenance of posture) are affected [Hamzat et al., 2014].

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It is important to consider differences in motor functioning improvement during varying phases of stroke recovery. Much of the emphasis on effective rehabilitation interventions has focused on the acute (0–3 months post stroke) and sub-acute (3–6 months post-stroke) phases, as it is widely believed that patients in the chronic phase (≥ 6 months post-stroke) are unable to make similar gains. Interestingly, this notion is challenged by the scientific literature; Teasell and coworkers reported that there is a large evidence base supporting rehabilitation interventions, for the chronic phase of stroke recovery [Teasell et al., 2014]. Previous systematic reviews have evaluated VR for balance in all phases of stroke [Li et al., 2016]; However, its effectiveness on Improving balance and is a critical component of addressing gait impairments; therefore, the objective of this study was to investigate the effects of different balance Techniques/Approaches on post stroke rehabilitation. Furthermore, we aimed to identify which training regimen was most effective.

Various strategies and treatment approaches aiming to improve patient function and independence have been developed over the years [Ifejica-Jones and Barrett, 2011]. In the last 20 years, neuroimaging techniques and the discovery of mirror neurons have brought about a deeper understanding of brain function [Sale and Franceschini, 2012]. This in turn has lead to the design of new treatment approaches such as action observation, constraint-induced movement therapy [McIntyre et al., 2012], bilateral rehabilitation [Hijmans et al., 2011], Mirror symmetric bimanual movement priming [Biblow et al., 2012], use of virtual reality, robotics [Cameirao et al., 2012], or mental representation of a motor action. This article focuses on the latter. Mental practice [Lum et al., 2012], or motor imagery training is a type of therapy in which the patient evokes a gesture or a movement so as to learn, reinforce, or improve performance of that movement. This activity has traditionally been used in athletics [Guillot and Mollet, 2008], in an initiative manner, with the aim of reviewing or reinforcing the sequence of movements that make up the action to be performed.

Objective of the study:

Treatment strategies have recently been developed for patients with neurological disorders [Garrison et al., 2010], but their effectiveness has yet to be proved. We need to identify the most effective procedure and the target patient, since certain lesions in some cases render the patient unable to visualise movement [Carrasco and Cantalapiedra, 2016]. So the objective of this study was to investigate the effects of different balance Techniques/Approaches on post stroke rehabilitation. Furthermore, we aimed to identify which training regimen was most effective.

Definitions Of The Study

Stroke is a significant health problem that affects patients, their families, and the health care system as well. Balance and coordination impairments are common complications of poststroke; these deficits impede individuals' abilities to participate in activities of daily living and reintegrate back into the community.

Maintaining one's balance requires continuous and simultaneous data processing from multiple systems (e.g. vestibular, visual, proprioception and cognitive reintegration). When these systems have been impacted by a neurological injury, such as stroke, balance and balance-contingent activities (i.e. ambulation or maintenance of posture) are affected.

Various strategies and treatment approaches aiming to improve patient function and independence have been developed over the years [Langhorne et al., 2011], Neuroimaging techniques and the discovery of mirror neurons have brought about a deeper understanding of brain function. This in turn has lead to the design of new treatment approaches such as action observation, constraint-induced movement therapy, bilateral rehabilitation, Mirror symmetric bimanual movement priming, use of virtual reality, robotics, or mental representation of a motor action. This article focuses on the latter. Mental practice/Motor imagery training (MP/MI), Visual Reality (VR), Mirror Therapy (MT), this study focused on these three approaches.

Definition Of The Term

According to the definition of the World Health Organization, we defined stroke a clinical syndrome consisting of rapid developing clinical signs of focal (or global in case of coma), disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin.' A transient ischaemic attack (TIA) is defined as stroke symptoms and signs that resolve within 24 hours.

The American Stroke Association Defined Stroke as a disease that affects the arteries leading to and within the brain. Stroke occurs when a blood vessel that carries oxygen and nutrients to the brain is either blocked by a clot or

bursts (or ruptures). When that happens, part of the brain cannot get the blood (and oxygen) it needs, so it and brain cells die. It is the No.5 cause of death and a leading cause of disability in the United States.

What are the types of stroke?

Stroke can be caused either by a clot obstructing the flow of blood to the brain (called an **ischemic stroke**) or by a blood vessel rupturing and preventing blood flow to the brain (called a **hemorrhagic stroke**). A **TIA** (transient ischemic attack), or "mini stroke", is caused by a temporary clot.

What are the effects of stroke?

The brain is an extremely complex organ that controls various body functions. If a stroke occurs and blood flow can't reach the region that controls a particular body function that part of the body won't work as it should.

Balance capacity was defined as the ability to maintain, achieve, or restore a state of balance during any posture [Hung et al., 2014]. This includes all different aspects of balance capacity as described in a model by Tyson and coworkers, like static and dynamic balance, body alignment, and weight distribution [Barcala et al., 2013]. Balance outcomes included in this study should assess any of these aspects and should be validated and found reliable for individuals with stroke. Balance outcomes should measure at the ICF (International Classification of Functioning, Disability and Health) level of body functions and structures (such as posturography) or capacities/activities (such as the Berg Balance Scale [BBS]).

Virtual reality (VR) or augmented reality, uses immersive multimedia to simulate an environment representative of a real or imagined place. These virtual realities are typically in game form and use sensory-motor experiences including sight, sound, and touch to simulate environments and activities. Computer screens with special displays are used to present visual imagery while headphones or speakers deliver sound. These immersive virtual environments can be used in balance training by providing continuous visual information to the user that can be used as sensory feedback by the vestibular system to create successful movements.

Mental practice or motor imagery training is a type of therapy in which the patient evokes a gesture or a movement so as to learn, reinforces, or improves performance of that movement. This activity has traditionally been used in athletics, with the aim of reviewing or reinforcing the sequence of movements that make up the action to be performed. There are 2 types of imagery techniques: external or visual, in which subjects imagine seeing themselves from the viewpoint of an external observer, and internal or kinaesthetic, in which subjects imagine the sensations of motion in their own bodies.

Hypothesis

Null hypothesis:

Mirror therapy and Visual reality are more effective in improving balance on stroke rehabilitation.

Alternative hypothesis:

Mental Practice/Mental Imagery is more effective in improving balance on stroke rehabilitation

Methods:-

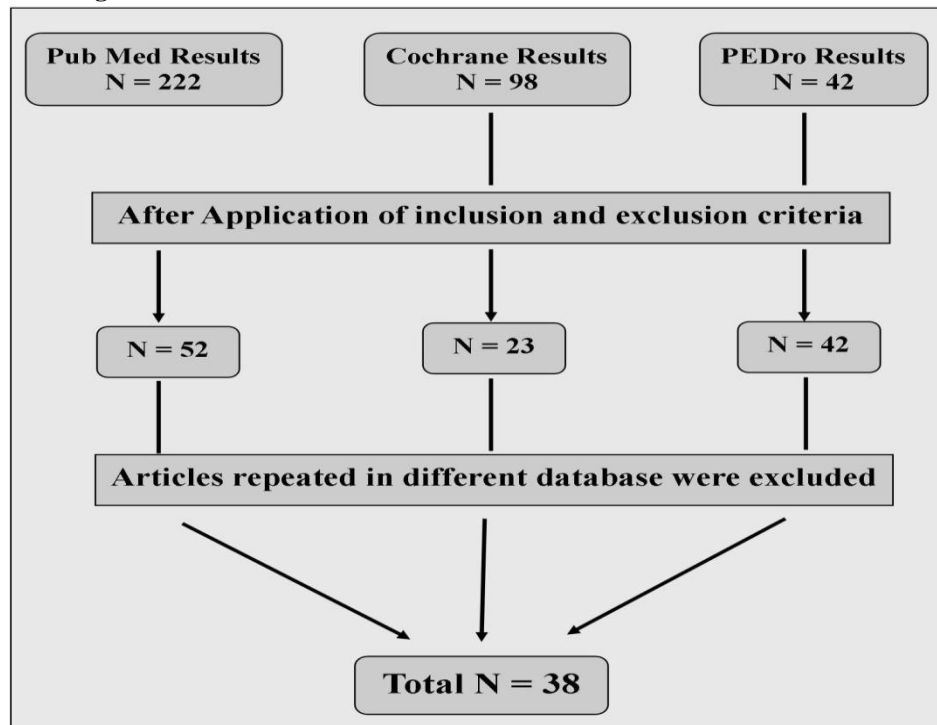
Methodological quality:

Studies were appraised on their methodological quality using the Physiotherapy Evidence Database (PEDro) tool. The PEDro tool is comprised of 10 "yes" or "no" questions, yielding a maximum possible score of 10. The methodological quality of a study was excellent if a PEDro score of 9–10 was achieved, good if 6–8, fair if 4–5, and poor if <4, according to established guidelines from the Evidence Based Review of Stroke Rehabilitation [Teasell, 2015].

We used the Jadad scale (Table 1) to assess the methodological quality of every article. This scale has been validated and its simplicity, effectiveness, and ease of use are widely recognised. It includes 5 items which assess whether patients have been randomised and if the randomisation method is adequate. It also assesses if the study is double-blinded and the blinding method is appropriate, and if dropout data are given [Clark et al., 1999].

Table 1:-Jadad scale

1	Was the study described as randomized?	YES	NO
2	Was the method of randomization described? Is that method appropriate?	YES	NO
3	Was the study described as double blind?	YES	NO
4	Was the method of blinding described? Is that method appropriate?	YES	NO
5	Was there a description of withdrawals and dropouts?	YES	NO
RESULTS			
5/5 =	Excellent methodological quality		
4/5 =	Good methodological quality		
3/5 =	Acceptable methodological quality		
2/5 =	Poor methodological quality		
1/5 =	Bad methodological quality		

Method Of Collecting Data:-**Figure 1:-Flow chart of the studies used and the outcome measure****Outcome Measures****Berg Balance Scale:**

The BBS is a 14-item scale that measures functional balance through a variety of standing exercises. The BBS is relatively short, requiring approximately 10–20 min to complete; further, its efficacy as an outcome measure has been validated in stroke populations [Blum and Korner-Bitensky, 2008].

Time Up Go Test:

The TUG assesses static and dynamic balance abilities.

The TUG measures the time in seconds it takes a person to stand from sitting on a chair, walk three meters, turn around and walk three meters back, and then sit back down on the chair. The TUG has been shown to be a reliable tool in the stroke population for measuring balance and gait [Ng and Hui-Chan, 2005].

Procedure**Table 2:-Overview of the reviewed studies and the result obtained**

General Information of the studies	Approaches/Technique used	Balance scale used	Improvement seen after the intervention
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Author: Kim et al.38 Type: RCT Duration: 4 days per intervention Participants: 15 Diagnosis: chronic hemiplegia	Four interventions: visual locomotor imagery training, kinaesthetic locomotor imagery training, visual locomotor imagery with auditory step rhythm, and kinaesthetic locomotor imagery with auditory step rhythm.	- Timed Up and Go - EMG of quadriceps, hamstring, tibialis anterior muscle, and calf muscle on the affected side - Kinematic data in sagittal plane	Authors compared both the techniques and concluded that kinaesthetic imagery may have greater therapeutic benefits for gait performance than visual imagery, and that adding an auditory step rhythm may accentuate these benefits.
Author: Guttman et al.32 Duration: 8 weeks Participants: 13 Disease: chronic hemiplegia	Two interventions: mental practice of transition from sitting to rising and reaching and grasping. 4 weeks later, type of intervention was changed so that all subjects practised both techniques.	- Fugl-Meyer - Timed Up and Go - Posture grid - Reaching Performance Scale - Virtual reality glove	Based on this evidence, the authors concluded that this technique is a promising cost-effective and non-invasive adjuvant to traditional therapy, which substantially reduces decline and improves functional results.
Author: Dunskey et al.40 Type: Controlled trial Duration: 6 weeks Participants: 17 Disease: subacute hemiparesis	Mental imagery programme for home-based gait training	Spatial-temporal parameters - Kinematic parameters - Tinetti - Modified Functional Walking Categories Index	Significant gains in walking speed after training (40%), and these gains were largely maintained at the 3-week follow-up evaluation. There were significant increases in stride length, cadence, and single-support time for the affected leg.
Author: Hwang et al.39 Type: Controlled trial Duration: 4 weeks Participants: 24 Disease: chronic hemiplegia	SG: MI of locomotion + conventional PT CG: Conventional PT + watching documentary on health	-Spatiotemporal parameters -Activities-Specific Balance Confidence Scale - Berg Balance Test - Dynamic Gait Index.	Also showed statistically significant improvements in gait speed, length of stride, hip flexion torque, and dynamic balance in the experimental group. The authors concluded that these improvements may be explained by the transfer of skills, as well as by the psychological components of mental imagery.
Author: Lee et al.37 Type: RCT Duration: 6 weeks Participants: 24 Disease: Chronic hemiplegia	SG: MI + treadmill gait training CG: Treadmill gait training	Computed analysis: - Speed - Rhythm - Cadence - Step length - Time on single limb support and double limb support	The authors detected improvements such as reduced double stance time in both the study and control groups, but they were more significant in the first group.
Author: Dijkerman et al.46 Type: Controlled trial Duration: 4 weeks Participants: 20 Diagnosis: Chronic hemiplegia	SG: PT + MP of a non-functional specific task 2 CG: - PT + visual imagery of previously seen pictures - PT exclusively	- Motor training task, Pegboard, dynamometer, position sensitivity, two-point discrimination, Recovery Locus of Control Scale, Elevator Counting of the Test of Every Day Attention, Barthel Index, and	The group with motor imagery training showed greater improvement when performing the trained task than was the case for other tasks.

		modified functional limitation profile	
Author: N Katz et al. Type: Experimental Duration: 4 weeks Participants: 19 Diagnosis: Right hemiplegia	SG: VR + Computerized visual therapy. CG: Conventional visual screening tasks.	-VR street crossing test -Real street crossing performance.	Despite several limitations in this study the present results support the effectiveness of the VR street program in the treatment of participants with USN, and further development of the program
Author: Young Kim et al Type: RCT Duration: 3 Weeks Participants: 24 Diagnosis: Unilateral spatial neglect (Rt hemisphere stroke)	SG: Visual reality CG: Visual scanning training	-Star cancellation test. -Line bisection test. - Catherine Bergego scale (CBS). - Korean version of modified Barthel index (K-MBI).	VR group were significantly higher than those of the control group after treatment, this suggests that virtual reality training may be a beneficial therapeutic technique on unilateral spatial neglect in stroke patients.
Author: Rong Li et al Type: RTC's Duration: 6 weeks Participants: 17 Diagnosis: All types of stroke	All studies used the patients received MI only	- Timed Up and Go Test (TUG). -Functional Ambulation Categories (FAC) -Functional Reach Test (FRT). -Fugle-Meyer assessment (FMA). - Berg Balance Scale (BBS)	This study aimed to evaluate the effects of motor imagery (MI) on walking function and balance in patients after stroke. MI appears to be a beneficial intervention for stroke rehabilitation. Nonetheless, existing evidence regarding the effects of MI in patients after stroke
Author: Mohan et al Type: RCT Duration: 2 Weeks Participants: 22 Diagnosis: Acute stroke	SG: Mirror therapy CG: conventional	-Fugle Meyer Assessment (FMA). -Brunel Balance Assessment (BBA) -Functional Ambulation Categories (FAC).	Administration of mirror therapy early after stroke is not superior to conventional treatment in improving lower limb motor recovery and balance, except for improvement in mobility.
Author: Jerome et al Type: RCT Duration: Participants: 20 Diagnosis: Chronic stroke	SG: Visual reality CG: conventional rehabilitation	-Berg Balance Scale (BBS) -Timed Up and Go test (TUG).	VR interventions compared to conventional rehabilitation had significant improvements.
Author: D Garcia et al Type: Clinical trial Duration: 6 weeks Participants: 23 Diagnosis: All types of stroke	SG: MP/MI CG: Other conventional therapeutic approaches for balance	-Berg Balance Scale (BBS) -Timed Up and Go test (TUG). -Fugle Meyer Assessment (FMA). - Dynamic Gait Index.	MP/MI is effective when used in conjunction with conventional physical therapy for functional rehabilitation of both upper and lower limbs, as well as for the recovery of daily activities and skills.
Author: DG Lee et al Type: RCT Duration: 4 Weeks Participants: 27	SG: MT + Neuromuscular electrical stimulation CG: conventional physical therapy alone.	Modified Ashworth Scale (MAS) was used to assess muscle tone, the Berg Balance Scale	MT combined with NMES is effective in improving muscle strength and balance in hemiplegic stroke

Diagnosis: Hemiplegic stroke		(BBS) and Timed Up and Go test (TUG)	survivors. However, further studies are necessary to demonstrate brain reorganization after MT combined with NMES.
Author: Ching et al Type: RCT Duration: 1.5 hours/day, 5 days/week, for 4 weeks. Participants: 33 Diagnosis: Chronic stroke	SG: Mirror therapy CG: The CT group received task-oriented training.	-Fugl-Meyer Assessment. -kinematic variables. -Normal movement timing	The application of MT after stroke might result in beneficial effects on movement performance, motor control, and temperature sense
Author: Hyun-Gyu et al Type: RCT Duration: 4 Weeks Participants: 20 Diagnosis: Hemiparesis (post stroke)	SG: Mirror therapy CG: Task oriented exercises	-Berg Balance Scale (BBS) -Timed Up and Go test (TUG). - Balance index and dynamic limit test	mirror therapy has been suggested as a beneficial treatment option with safe application to improve the postural control and balance function of patients with post stroke hemiparesis.

Discussion:-

Most studies on mental practice published to date have assessed its effectiveness in relearning tasks performed with the arms. However, its utility in gait relearning has also been studied although to a lesser extent. Verma and coworkers assessed the effectiveness of a training programme which included a task-oriented circuit for gait rehabilitation combined with mental imagery [Carrasco and Cantalapiedra, 2016]. They found statistically significant improvements in most of the outcome measures, and independent functional gait also improved earlier than in the control group. Improvements remained until at least 6 weeks after therapy.

All these studies attest that mental imagery training is able to improve spatiotemporal gait parameters, especially when combined with other therapies such as task-oriented circuit training or auditory step rhythm signals. Motor imagery also seems to reduce the psychological component of fear of falling, thereby promoting walking at an earlier moment and increasing the patient's functional independence. Lastly, authors observe that mental imagery is a safe and low-cost technique that can be performed even without supervision once the patient has completed appropriate training.

VR was found to improve static and dynamic balance in chronic stroke patients. Among all VR intervention types, postural VR training was shown to provide the greatest benefit by significantly improving both the BBS and TUG.

Amidst the limitations acknowledged in this study, this review encourages the use of VR interventions for the recovery of impaired functional balance in chronic stroke patients.

Mohan along with his coworkers assess the efficacy of mirror therapy using functional movement synergies on lower extremity motor recovery, balance, and mobility in acute stroke patients [Mohan et al., 2013].

The mirror therapy program for lower extremity motor recovery which included isolated non paretic ankle dorsiflexion movements for chronic stroke subjects, our study mirror therapy program consisted of functional movement synergies as voluntary movement patterns are functionally specific units of muscles and joints that are constrained by the central nervous system to produce an action with precise spatial and temporal organization. Furthermore the mirror group exhibited better performance in ambulation categories than the control group, whereas lower extremity motor recovery and balance did not show significant difference when compared between the groups.

Conclusion:-

After going through all the articles, we conclude that both the three approaches (Mental Practice/Mental Imagery MP/MI, Visual Reality VR, and Mirror Therapy MT) were effective, but MP/MI is more effective according to my studies, one thing we observed that mental imagery is a safe and low-cost technique that can be performed even without supervision once the patient has completed appropriate training. Furthermore there are some patients that are having visual and auditory impairments associated with stroke.

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