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PILOT STUDY

THE Effect Of Exercises To Improve Balance Using Mirror As A Feedback In Stroke Patients

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ABSTRACT:

Context: Though little attention has focused on the use of mirror therapy intervention on lower extremities post-stroke. The potential use of visual feedback is a review in this study, focusing on visual mirror feedback and was performed for two reasons. One is for the development of exercise for improving stroke patient's muscle power, balance and gait after verifying the result of the exercise. The other is by applying this exercise into the clinical trial was useful on hemiplegic stroke patients.

Method: Patients with stroke were screened at baseline, and post-intervention (after two weeks) balance was assessed using the Berg Balance Scale (B.B.S.). Exercises were given for five days /week for two weeks.

Results: The results of the paired t-test shows the comparison between the pre and post-B.B.S. was extremely significant (p value=0.0005)

Conclusion: Thus, we conclude that using the mirror as feedback for lower limbs can improve balance in stroke patients.

Key-words: Stroke, Mirror, exercises, Balance and Gait.

Introduction:

Although the word "stroke" is centuries old. In the year 1970, the World Health Organization defined stroke as a "neurological deficit of cerebrovascular cause that persists beyond 24 hours or is interrupted by death within 24 hours". A stroke is a medical emergency, and it can cause permanent neurological damage or death1. In 2004 Cerebrovascular disease was the second leading cause of death worldwide. Stroke is one of the leading deaths and causes of disability worldwide, though, of all, up to 80% of cases may be prevented by reducing the individual's risk[2]. The resulting problems include body unbalance, decreased weight-shifting capacity, asymmetric posture [3,4] and has difficulties in performing functional activities such as Walking[5]. Generally, due to shifting the centre of gravity to the non-paretic side, hemiparetic patients compensate for restricted movement and muscle weakness[5]. Due to the paretic side's muscle weakness, compensation strategy makes weight shifting to the paretic side inefficient and perpetuates[6]. Therefore, improving functional movements of stroke patients by strength training exercises may target activation of the paretic lower extremity muscles[7]. These disabilities may weaken or paralysis of the muscles, abnormal muscle tone, associated reaction, coordination disorder, and problems with the musculoskeletal system. There is decreased motor ability and restriction in the functional use of the paretic upper extremity[8].

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Frequently balance abnormalities are present in hemiparetic stroke patients. Fall risk increases due to balance impairments, resulting in social problems and high economic costs[9,10,11]. In postural control, three sensory modalities are mainly involved: somatosensory, visual, and vestibular afferents. For adequate postural control, the integration of information from these systems is crucial. Balance impairments and decreased ankle proprioception are positively correlated in patients with stroke. Abnormal postural reactions could be the source of abnormal interactions between the three sensory systems involved in balance[12,13,14]. Various studies have been conducted on the exercise methods for stroke patients, focusing especially on improving muscle strength, balance and walking ability, which are essential for daily routine. Ng and Shepherd[15] reported that muscle strengthening exercise improves muscle strength and function without increasing abnormal muscle activities. In recent years, several studies have reported a significant correlation between muscle strength and function[16,17]. Balance and gait have been studied as clinically essential factors for a long time[18]. Due to the reduced balance of moves to the unaffected leg for stability, asymmetry is created to produce force in lower limbs[19]. The balance ability to maintain hip joints' stability against external sway is reduced due to lack of symmetric weight bearing [20]. Consequently, stroke patients have big obstacles to recovery due to postural sway in standing position, asymmetric body balance, and disruption of controlling weight-bearing and walking ability[21]. Therefore, balance retaining is one of the most important elements in the treatment of neurological impairment, such as one in stroke patients[22]. The learning with the sensory-feedbacks is a visual sense, among other senses, can receive information more accurately than other senses. The motor learning method using visual feedback has been widely used for balance training of stroke patients. In a study carried out on balance disorder patients, De Haart[23] reported that visual feedback training improved posture controlling function. Patients trained with visual feedback can perform tasks with interest in the treatment process, and their motivational effect is maximized through the entire treatment process. In addition, patients can perform continuous and repeated training and learning with this method and immediately check the task performance outcome. Therefore, this seems to be an appropriate evaluation and training method for hemiplegic patients[24].

Another exercise method, mirror therapy using visual information, was initially introduced by Ramachandran and colleagues for the treatment of phantom limb pain. In the late 1990s, Altschuler et al. introduced stroke rehabilitation using mirror therapy; they reported that range of motion, speed and dexterity of the affected arm was improved by mirror therapy[25]. Mirror therapy (M.T.) provides a form of visual feedback by having the patient watch his/ her unaffected extremity's reflection in a mirror[26]. Sathian, Arlene, Greenspan, Steven, and Wolf [27] found that the paralyzed arm's motion and grip strength have improved after a 2 week of mirror therapy. Stevens et al. [28] also reported increased Fugl-Meyer Assessment scores and active range of motion, hand dexterity and velocity of motion by applying a mirror therapy to stroke patients for 3-4 weeks. Similarly, studies also reported that there is a better recovery effect with only rehabilitation therapy than mirror therapy[29].

Stroke is a significant impairment that reduces major daily activities and balance due to lower limb involvement. In previous research, the upper limb functions were mainly focused on mirror therapy. However, since lower limb function after stroke is also damage that affects the independent daily functions, more studies are required related to the lower limb functions to explore the issue of mirror therapy and balance ability.

The balance needs to improve even the mirror is a major treatment of choice for upper limb exercises and improve the movements' accuracy even it was used for lower limb movements improvement. This study's main purpose is to determine the effectiveness of mirror therapy on balance in chronic stroke patients.

MATERIAL AND METHODOLOGY –

Participations: The present study was conducted on 06 patients of stroke who consented to participate in the study. The study was performed in the Physiotherapy O.P.D. The present study is an experimental study with a Purposive sampling method. In this study, before its initiation, all the subjects voluntarily consented to participate. After the approval granted by the Institutional Review Board, data collection was carried out. Inclusion Criteria were the First episode of unilateral stroke with hemiparesis. The patient should stand independently, a score of greater than 24 on the MMSE, Only mild spasticity in all joints of the affected limb (Modified Ashworth Scale score < 2), Voluntary control grading 1-3 and Age 23-65, both gender. Exclusion Criteria were any other pre-existing neurological disorder other than the stroke. Any additional psychological or medical condition that would affect the patient's ability to comply with study, patients with impaired vision or aphasia, and diagnosis muscular-skeletal disorder, operation of the lower extremity and Fixed ankle or foot contracture.

Procedure –

The ethical clearance was obtained from the Institute ethical committee for study. After ethical committee clearance, six patients were selected for the study based on inclusion and exclusion criteria. The procedure was explained to the assigned patients of hemiparesis, and consent was taken from them.

Selected patients were screened by Mini-Mental scale, Modified Ashworth Scale & Voluntary control grading. In the Mini-Mental Scale examination, the score should be ≤ 24. In the Modified Ashworth Scale, the score should be <2. Voluntary control grading must be 1-3. Once they fulfil, the criteria was a part of the study.

Participants received training five days/week for two weeks. Patients received exercises for 40 minutes /day, with a 10 minutes rest period halfway through the session.

A mirror was kept on a stand in front of the patient. The reflective surface of the mirror was kept facing the patient. The exercises were performed in a standing position by the subject, which is: (1) One leg standing, (2) Hip extension, (3) Hip abduction, (4) Squats, (5) Lunges and (6) Sit to Stand. Each of the above exercises was performed in 2 sets of 10 repetitions.

Outcome Measures:

The balance was assessed using the Berg Balance Scale (B.B.S.) at baseline and after 2 weeks. The same investigator performed clinical evaluations.

The parameter of this evaluation was as follows:

Description:

14-item scale designed to measure the balance of the older adult in a clinical setting. Equipment needed: Ruler, two standard chairs (one with armrests, one without), and footstool or step, stopwatch or wristwatch, 15 ft walkway

Completion:

Time: 15-20 minutes

Scoring: A five-point scale, ranging from 0-4 where "0" indicates the lowest function level and "4" the highest level of function. Total Score = 56

Interpretation: 41-56 = low fall risk

21-40 = medium fall risk

0 –20 = high fall risk

A change of 8 points is required to reveal a genuine change in function between the two assessments.

ITEM DESCRIPTION SCORE (0-4)

Sitting to standing _____

Standing unsupported _____

Sitting unsupported _____

Standing to sitting _____

Transfers _____

Standing with eyes closed _____

Standing with feet together _____

Reaching forward with outstretched arm _____

Retrieving object from floor _____

Turning to look behind _____

Turning 360 degrees _____

Placing alternate foot on stool _____

Standing with one foot in front _____

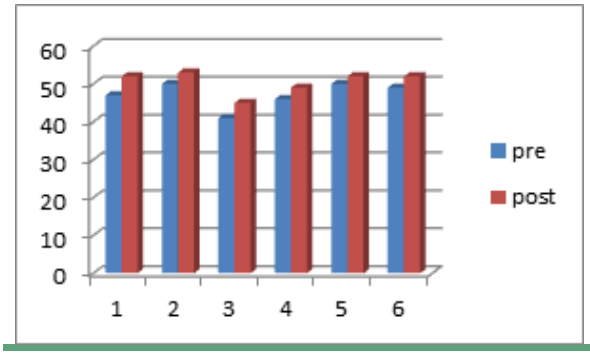
Standing on one foot _____

Total _____

RESULT AND DATA ANALYSIS:

Statistical analysis was performed by using Graph Pad In Stat software version 3. Descriptive analysis was used to find out mean and standard deviations for outcome measures. Graph 1 shows the pre and post score of the Berg Balance Scale. Table 1 shows that the mean of pre-B.B.S. was 47.16 and post-B.B.S. was 50.50. The standard deviation for per B.B.S. was 3.43, and post-B.B.S. was 3.01. There is also a coefficient correlation between pre and post-B.B.S. (r value=0.9567). The paired t-test shows that the comparison between the pre and post-B.B.S. was extremely significant (p value=0.0005 and t value 7.906).

Graph 1: Berg Balance Scale Score



Graph 1 show the pre and post score of Berg Balance Scale.

Table 1: Data Analysis of the pre and post BBS

	PRE BBS	POST BBS
Mean	47.16	50.50
Standard deviation	3.43	3.01
P value	0.0005	
T value	7.906	
R value	0.9567	

Table 1 shows that the mean of pre-B.B.S. was 47.16 and post-B.B.S. was 50.50.

DISCUSSION:

In adults, stroke is the primary cause of severe long-term disability. More than 60% of stroke survivors suffer from constant neurologic deficits that break activities of daily living. After a stroke of the lower-extremity, motor function is frequently impaired, causing limitations in functional mobility. It has been revealed that the motor system's functional association, including the primary motor cortex, can be modulated by both passive inspections of movement of the contralateral limb and ipsilateral limb movement.

A relatively new therapeutic intervention that focuses on moving the unimpaired limb is mirror therapy. In stroke patients, mirror therapy creates a visual illusion of the impaired limb's better movement ability, which involves performing movements of the unimpaired limb while examining its mirror reflection superimposed over the (unseen) impaired limb.

Balance is a complex motor skill that depends on relations among multiple sensorimotor processes, environmental and functional contexts. Different impairments can cause balance in hemiparetic patients after stroke in the physiological systems involved in postural control, including sensory afferents,

movement strategies, biomechanical constraints, cognitive processing, and verticality perception. Balance impairments and disabilities must be appropriately addressed.

For improving muscle strength, balance, and walking ability of hemiplegic stroke patients, this study was conducted to determine the effect of exercises on the lower limb muscle strength, balance and walking ability of the patients and apply these results into clinical practice. We examined the effects of exercises using visual feedback from a mirror for patients with stroke in a standing position in this study. The subjects showed a significant increase in the Berg Balance score after the treatment, implying that mirror therapy effectively improves balance ability according to the result.

Our study also supports the finding by Je-Hyeok Lee 30 that Close kinetic chain lower limbs exercise showed more practical and significant in improving muscle power, balance and gait of stroke patients. Especially, using mirrors to exercise is considered a more effective method than without mirrors. These findings indicate that using a mirror for exercise is very effective for hemiplegic stroke patients.

We also found that there was a significant improvement between the pre and post berg balance scale. Our study also positively correlates with the study done by Ted J Stevenson31, who found out in his study that all groups showed statistically significant increases in B.B.S. performance from Time 1 to Time 3. Clinicians supposed improvement in balance ability over this time frame in 34/45 (76%) subjects no change perceived in 10/45 (22%) of subjects.

Our study has some limitations about the interpretation of its results. One of them is a very small sample size. For better result, this study should be carried out further on larger groups of subjects. Thus we conclude that balance is improved when exercises for the lower limbs are given using the mirror as visual feedback in stroke patients.

CONCLUSIONS:

This study's initial findings suggest that Mirror therapy can be a helpful intervention addition in the treatment of patients; it also provides a simple and inexpensive adjunct intervention. Our study research shows positive results. We determined that mirror therapy is a useful tool for the functional rehabilitation of lower limb in stroke patients. A significant quantity of research has been undertaken to assess the effects of exercise on balance and functional ability in stroke patients. Exercise appears to have statistically significant beneficial effects on balance ability. Although it has been seen that Mirror Therapy helps improving function in hemiparesis, still it is unclear that to which stage is benefitted the most from a stroke. Many other research pieces have to be conducted to streamline the possibility, dosage, and patient population who would benefit the most. Also, follow-ups and carryover should be studied well. Further studies are needed to validate its effectiveness.

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REFERENCES-

1. V. L. Feigin, M. H. Forouzanfar, R. Krishnamurthi et al., "Global and regional burden of stroke during 1990–2010: findings from the Global Burden of Disease Study 2010," The Lancet, vol. 383, no. 9913, pp. 245–254, 2014.
2. Nichols M, Townsend N, Luengo-Fernandez R, et al., 2012, Royal College of Physicians National Sentinel, 2011, Stroke Clinical Audit 2010, Round 7, Public report for England, Wales and Northern Ireland, p. 43
3. Ikai T, Kamikubo T, Takehara I, et al.: Dynamic postural control in patients with hemiparesis. Am J Phys Med Rehabil, 2003, 82: 463–469, quiz 470–472, 484.
4. Carr JH, Shepherd RB, Nordholm L, et al.: Investigation of a new motor assessment scale for stroke patients. Phys Ther, 1985, 65: 175–180.
5. Eng JJ, Chu KS: Reliability and comparison of weight-bearing ability during standing tasks for individuals with chronic stroke. Arch Phys Med Rehabil
6. Thielman G, Kaminski T, Gentile AM: Rehabilitation of reaching after stroke: comparing 2 training protocols utilizing trunk restraint. Neurorehabil Neural Repair, 2008, 22: 697–705.
7. Moreland JD, Goldsmith CH, Huijbregts MP, et al.: Progressive resistance strengthening exercises after stroke: a single-blind randomized controlled trial. Arch Phys Med Rehabil, 2003, 84: 1433–1440.
8. Woodson AM: Stroke. In: Radomski MV, Trombly Latham CA (Eds.), Occupational Therapy for Physical Dysfunction, 6th ed. Philadelphia: Lippincott Williams & Wilkins, 2008, pp 1001–1041.
9. Harris JE, Eng JJ, Marigold DS, Tokuno CD, Louis CL. Relationship of balance and mobility to fall incidence in people with chronic stroke. Phys Ther. 2005; 85(2):150–58.
10. Belgen B, Beninato M, Sullivan PE, Narielwalla K. The association of balance capacity and falls self-efficacy with history of falling in community-dwelling people with chronic stroke. Arch Phys Med Rehabil. 2006;87(4):554–61.
11. Chen IC, Cheng PT, Hu AL, Liaw MY, Chen LR, Hong WH, Wong MK. Balance evaluation in hemiplegic stroke patients. Chan Gung Med J. 2000;23(6):339–47.
12. Podsiadlo D, Richardson S. The timed "Up & Go:" A test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142–48.
13. Sanford J, Moreland J, Swanson LR, Stratford PW, Gowland C. Reliability of the Fugl-Meyer assessment for testing motor performance in patients following stroke. Phys Ther. 1993;73(7):447–54.
14. Benaim C, Pérennou DA, Villy J, Rousseaux M, Pelissier JY. Validation of a standardized assessment of postural control in stroke patients: The Postural Assessment Scale for Stroke Patients (PASS). Stroke. 1999;30(9):1862–68.
15. S. S. Ng, and R. B. Shepherd, "Weakness in patients with stroke: implications for strength training in neurorehabilitation," Physical Therapy Reviews, vol. 5, no. 4, Dec. 2000, pp.227-238.
16. S. Nadeau, D. Gravel, and A. B. Arsenault, "Dynamometric assessment of the plantarflexion in hemiparetic subjects: relations between musculae, gait and clinical parameters," Scandinavian Journal of Rehabilitation Medicine, vol. 29, no. 3, Sep. 1997, pp.137-146.

17. K. Suzuki, G. Imada, and T. Iwaya, "Determinants and predictors of the maximum walking speed during computer-assisted gait training in hemiparetic stroke patients", Archives of Physical Medicine and Rehabilitation, vol. 80, no. 2, Feb. 1999, pp.179-182.

18. J. Perry, "The mechanics of walking in hemiplegia", Clinical Orthopaedics and Related Research, vol. 63, Mar-Apr. 1969, pp. 23-39.

19. J, J. Eng, and K. S. Chu, "Reliability and comparison of weight-bearing ability during standing tasks for individuals with chronic stroke," Archives of Physical Medicine and Rehabilitation, vol. 83, no. 8, Aug. 2002, pp.1138-1144.

20. R. Dickstein, Z. Dvir, A. B. Jehosua, M. Rois, and T. Pillar, "Automatic and voluntary lateral shifts in rehabilitation, vol. 8, no. 2, May. 1994, pp.91-99.

21. K.-E. Jang, K.-B. Seo, and S.-J. Lee, "Quantitative Assessment of Balance Using Balance Index," Journal. Of Korean Academy of Rehabilitation. Medicine. vol. 18, no. 3, Sep. 1994, pp.561-569.

22. B.-Y. Hwang, "Characteristics of L.O.S. and Body Sway in the Patients," Natural Sciences., Yong-In University. vol. 7, no. 1, Dec. 2002, pp.135-140.

23. M. De Haart, A. C. Geurts, S. C. Huidekoper, L. Fasotti, and, J. van Limbeek, "Recovery of standing balance in post acute stroke patients: a rehabilitation cohort study," Archives of Physical Medicine and Rehabilitation, vol.85, no. 6, Jun. 2004, pp.886-895.

24. A.A. Rizzo, T. Bowerly, J. G. Buckwalter, D. Klimchuk, R. Mitura, and T. D. Parsons, "A virtual reality scenario for all seasons: the virtual classroom," C.N.S. Spectr, vol. 11, no.1, Jan. 2006, pp.35-44.

25. Altschuler EL, Sidney B, Wisdom SL, Foster C, Galasko D, Llewellyn DM, et al. rehabilitation of hemiparesis after stroke with a mirror. Lancet 1999; 353:2035e6.

26. Small SL, Buccino G, Solodkin A: The mirror neuron system and treatment of stroke. Dev Psychobiol, 2012, 54: 293–310.

27. K. Sathian, I. Arlene, Greenspan and L. Steven Wolf, "Doing It with Mirrors: A Case Study of a Novel Approach to Neurorehabilitation," Neurorehabil Neural Repair, vol.14, no. 1, Mar. 2000, pp.73-76.

28. J. A. Stevens, and M. E. P. Stoykov, "Using Motor Imagery in the Rehabilitation of Hemiparesis," Archives of Physical Medicine and Rehabilitation, vol. 84, no. 7, Jul. 2003, pp.1090-1092.

29. M.. Beninato, L. G. Portney, and P. E. Sullivan, "Using the International Classification of Functioning, Disability and Health as a framework to examine the association between falls and clinical assessment tools in people with stroke," Physical Therapy, vol. 89, no. 8, Aug. 2009, pp.816-825.

30. Je-Hyeok Lee, Hyun-Joo Kim, Effect of exercise program using mirrors for stroke patients,"International Journal of Contents, Vol.9, No.1, Mar 2013.

31. Ted J Stevenson, "Detecting change in patients with stroke using the Berg Balance Scale, "Australian Journal of Physiotherapy Vol. 47, 2001.