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Comparative Study of Mental Imagery, Embedded Mental Imagery and Balance Training in Improving Balance Control Ability in Geriatric Population

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Abstract:

Objectives: This study is designed to test the effects of a 2-week trial of mental imagery, embedded mental imagery, balance training in improving balance control ability in geriatric population.

Methods: Fifty eight elderly (30 females and 28 males) were recruited from a community and conveniently assigned into 3 groups. The experimental group A received mental imagery training, group B received mental imagery with balance training (embedded mental imagery training), while group C received of balance training. The study lasted for 2 weeks, 6 intervention sessions, with each intervention session lasting for 45 minutes. Pre- test and Post- test outcome measures included the Berg Balance Scale (BBS), Activities-specific Balance Scale (ABC), and Single Limb Stance Test (SLST). Data was collected 2 times: one during the baseline at the initial of the intervention, and one following the two week intervention. Analysis of variance was performed.

Results: One-way ANOVA test on the result of Berg Balance Scale between the group revealed statistical significance difference in *post intervention values (p=0.003). Post hoc LSD shows significant result for post BBS values in group A-B (p=0.001) whereas for group A-C BBS was statistical significant (p=0.004).*

Conclusion: Current evidence suggests that mental imagery provides additional benefits to conventional physiotherapy. Finding in present concludes that embedded mental imagery may hence be an important therapeutic tool to improve balance in elderly. Further research is warranted to determine the effect of mental imagery on balance in this population. Longer interventions, further validation of mental imagery for this population and quantification of tests of balance is recommended.

Key words: Balance, Geriatrics, Mental Imagery

Introduction:

Balance is of special concern in the elderly due to its relationship with mobility and functional independence. Given an ageing population and the rising costs of medical care, it is important to examine methods of preventing or slowing the decline of postural control in the elderly. [4]

The increase in the incidence of falls among the elderly represents a serious problem, accentuated with the aging of the population. Each year, it is estimated that one-third of the population aged 65 years and older and half the population aged 80 years and older experience a fall and difficulty with ambulation.[11,1]

A substantial amount of research has been done to identify the risk factors for falls in the elderly and to screen for individuals who require intervention. Nonetheless, impaired balance has been identified as a risk factor for falling, both in prospective studies and in cross-sectional studies comparing elderly individuals with a history of falls to those how have not fallen.[4]

Balance and its neuromuscular foundation also deteriorate with age, although less predictable than strength, balance too has been shown to be responsive to training. Retraining balance involves both treatment of the underlying biomechanical constraints and adaptive training under a variety of conditions. There is evidence that flexibility and range of motion can be improved in the elderly who undertake exercise programmes.[18,4]

Study reveal that aging men and women have diminished postural control, associated with cognitive and brain structural involution, in unstable stance conditions and with diminished sensory input but are capable of stabilizing quiet standing with adequate sensory aids. Rehabilitative efforts provide evidence indicating that elderly who have undergone physical training can improve postural control and reduce fear of falling. Their data suggest that such improvement may occur even in the presence of non-specific, age-related brain degradation and cognitive decline.[7]

Beneficial effect of balance and mobility related exercise intervention have been demonstrated, for example, in healthy and frail older adults. Providing individuals with additional sensory information on their own motion, i.e. biofeedback, during training may enhance movement performance. Depending on the functioning of the natural senses that contribute to balance control, i,e. the vestibular, somatosensory, and visual system, the biofeedback may be used as a substitute or as an augmentation in the central nervous system's sensorimotor integration.[1]

A well-established motor-learning principle is that practice or repetition of a task improves movement and response time for that task. Older individuals are capable of improving movement performance and response times with practice, just as are other age groups.[17]

In order to improve balance abilities, many studies have adopted wide range of training methods involving balance training with visual feedback, muscle strength training, plyometric, virtual reality and mental training.[14]

Motor imagery has its origin in the sports psychology and behavioural psychology in the end of 19th century. It involves rehearsing a known motor act without any visible muscle contraction or motor output.[6]

Mental imagery is the umbrella term for the active process of reliving sensation with or without external stimuli. This is facilitated by the use of images brought about by combinations of the different modalities i.e. visual, auditory, tactile, kinaesthetic, gustatory. When movement of an action of a person or object is imaged this is referred as movement imagery. Specifically when it is the human body that is imaged by the internal reactivation of action within working memory without overt motor output it is called as motor imagery.[19]

A new model is proposed to emphasize the key role of motor imagery as an essential process of mental practice.[19,13]

Numerous studies have indicated that motor imagery may result in the same plastic changes in the motor system as actual physical practice. Motor imagery is the mental execution of a movement without any overt movement or without any peripheral (muscle) activation. It has been shown that motor imagery leads to the activation of the same brain areas as actual movement.[28]

Recent advances in the field include the use of techniques for mapping brain activity and probing cortical excitability, as well as observation of brain lesion patients during imaging tasks; these advances provide new insights into the covert aspects of motor activity.[20]

Mental Training has been used in a range of fields (e.g. sports psychology, cognitive psychology, medical science) as a motor learning method for acquiring and enhancing motor skills. Many studies have suggested that Mental Training could be used effectively to enhance motor skills or task performance, due to lower energy consumption than Physical Training for individuals who fatigue easily.[14]

Mental imagery is a conscious mental rehearsal of a motor act without performing any overt movement and implies that subject feels himself executing a given action. Mental practice effects are primarily associated with cognitive-symbolic rather than motor elements of the tasks. The cognitive elements referred to would include remembering a sequence of events; mentally reviewing salient task elements based on instructions, observation, or an initial physical performance; predicting the outcomes of various strategies; and using imagery to aid in spatial or temporal orientation[3,21]

Stimulation hypothesis states that movement execution, motor imagery, and action observation are all driven by the same basic mechanism. Motor imagery and action observation are conceived as “offline” operations of the motor areas in the brain.[28]

The safe performance of balance and mobility related activity during daily life, such as standing while performing manual task, rising from the chair and walking requires adequate balance control mechanisms. Because of the high incidences of balance and mobility disorders in older adults and the large negative impact for the individual, intervention are necessary that optimize the performance of balance and mobility related activities in specific target population of older adults. Thus, the purpose of this study was to investigate the effect of Mental Imagery on balance and to examine the potential usefulness of Mental Imagery for improving physical performance in health care for elderly population.[1]

Methods:

Fifty-eight subjects aged 60 to 93 years.[16,23,29] (30 women and 28 men) volunteered for this study. All give there informed consent before participating. The eligibility criteria were an age of 60 years and over and independent living in the community. Subjects were divided into three groups A, B, C respectively. Able to understand verbal commands (score of Mini Mental State Exam) MMSE above >/24.[7,9,12,18] No history of changes in gait and balance.[14,22] Can ambulate independently without assistive device.[14,22] No subjects presented with neurological disorders,[14] orthopaedic disorders in the ankle, knee or hip joint.[14,18] Subjects were also excluded if they reported use of medication known to impair balance (neuroleptics or benzodiazepines),[18] subjects with visual or somatosensory impairment[23] and auditory or speech deficits,[29] cardiovascular disease symptomatic during exertion,[18] subjects with hip or knee replacement.[18]

Procedure:

Subjects were recruited from a local community assisted living centre based on the inclusion and exclusion criteria. The study will be explained in detail to the subject and an informed consent form will be taken from them. The subjects will be divided into three groups Group A, Group B and Group C mental imagery, mental imagery combined with physical practise and physical practise respectively.

Eligibility criteria included and acceptable scores on two intake screens, the Mini-Mental State Exam (MMSE) and Movement Imagery Questionnaire-Revised (MIQ-R).[8]

Outcome measures consisted of standardized measures of balance, and balance confidence. These included Pre-test and Post-test measures on the Activities-specific Balance Confidence Scale (ABC),[10,30]

Single limb stance test (SLST),[24] the Berg Balance Scale (BBS)[10,30]

Each subject was tested by the same examiner at both time periods using standardized instructions. Pre-test & post-test conditions for all outcome measures were standardised as much as possible in terms of location, equipment, and instructions. Subjects were given the instructions on how to perform each test and asked if the directions were understood. Subjects were also informed that tests would not begin until they felt ready to perform the task. For the BBS, each subject was allowed only one trial. Examiner stood in close proximity to subjects during the Berg Balance Scale and Single Limb Stance Test to ensure safety. After completion of the two functional tests, the Activities-specific Balance Confidence Scale was administered in sitting position.

All subjects were assigned to their respective groups. The setting for all the sessions was quiet, comfortable that allowed for adequate ambient light and air, and offered a spacious area to move. All subjects received six physiotherapy sessions over two week intervention period i.e. 3 times a week. Overview of training session [Balance training in all three groups were same (The center for Physical Activity and Aging's strength and balance exercise program)].

Mental imagery group A subjects performed Mental imagery for 45 minutes. 10 minutes mental imagery of flexibility, 30 minutes of motor imagery of motor task and 5 minutes mental relaxation. Of the 20 subjects who met eligibility criteria, two subjects voluntarily declined any further participation during the study for personal reasons. Subjects trained to perform the entire task. The subjects were asked to stand on a bare floor in a relaxed posture with eyes closed and perform mental imagery focusing on the kinaesthetic and visual awareness.

Embedded mental imagery group B the MI intervention will be embedded into treatment session of the six therapy sessions which last for 45 minutes each. Including 10 minutes of flexibility followed by 30 minutes of embedded mental imagery at last 5 minutes of cool down and relaxation activities. The complete motor task will be divided into its stages. Each stage will be mentally rehearsed before and after it is once physically practised. The complete balance training was divided into its 9 tasks. Each task was imagined 5 times before it was physically practised once. At the end of each session, subjects imagined the complete task four times while lying supine on the treatment bench and four times while standing against a wall.

Balance training group C, the balance exercise program starts with a 10-minute warm-up, which includes flexibility exercises performed in seated and standing positions. Thirty minutes of band and balance training follows, then five minutes of cool-down and relaxation activities. Tasks for all the groups were static balance stance include semi tandem, full tandem, up on toes, one foot, centre of gravity shift includes stepping in different direction, reaching, object on floor, heel to toe walk (tandem walking), chest press in semi tandem, lateral pull downs in full tandem stance, chair squat, leg press on one foot, leg kicks, exercise with partner.

Data Analysis:

Statistics are performed by using SPSS version-16. Paired t-test, one-way ANOVA, post hoc-LSD was used for analysis of data. Paired t-test was applied to compare the data within the groups. One-way ANOVA was used to compare the data between the groups. Post Hoc analysis of multiple comparison tests were applied to compare between the groups. The statistical significance was set at 0.05 at 95% confidence and P value <0.05 was considered significant.

Results:

Subjects with the age group 60-93 were included in the study, so the mean age values shown in Table 1 in different groups respectively.

Table1: Demographic Data

	MEAN			SD		
	group A	group B	group C	group A	group B	group C
AGE	68.11	68.52	68.95	6.55	6.20	7.67

Post hoc-LSD concerned with finding patters and / or relationships between subgroups. Post-hoc examination strengthens induction by limiting the probability that significant effects will seem to have been discovered between subgroups of a population when none actually exist. In our study Group A-B POST ABC was insignificant (p=0.9.9), POST BBS was significant statistically (p=0.001), POST SLST was insignificant (p=0.819).

Group A-C POST ABC and SLST was statistically insignificant i.e. (p=0.883) and (p=0.838) respectively. Only POST BBS shows statistical significance with (p=0.004).

Group B-C POST ABC, BBS, SLST all values were statistically insignificant i.e. (p=0.789), (p=0.651), (p=0.975) respectively.

Table 2: Post Hoc Analysis

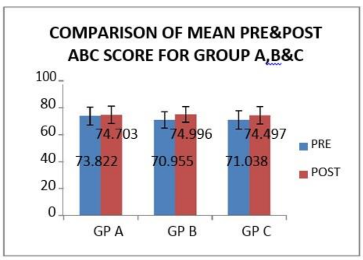
GROUP	MEAN DIFFERENCE			SIG		
	POST ABC	POST BBS	POST SLST	POST ABC	POST BBS	POST SLST
A-B	.23330	-1.65205	.58626	.909	.001	.819
A-C	-.29437	-1.43651	.51032	.883	.004	.838
B-C	-.52767	.21554	-.07594	.789	.651	.975

Paired t-test was done to compare the data of ABC, BBS, SLST within the groups.

For ABC all the groups showed significant difference [Group A (p=0.000), Group B (p=0.000), Group C (p=0.000)].

Table 3: Within Group Analysis of ABC Score

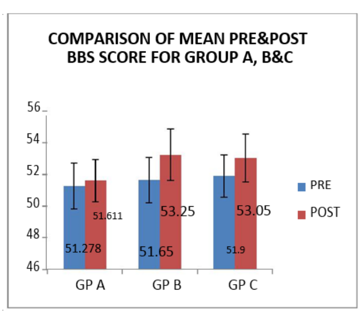
	MEAN		SD		T	P
	PRE	POST	PRE	POST		
GROUPA	73.822	74.703	6.748	6.407	-5.126	.000
GROUP B	70.955	74.996	5.930	5.753	-12.57	.000
GROUP C	71.038	74.497	6.846	6.449	-13.09	.000



For BBS all the groups showed significant statistical difference [Group A (p=0.010), Group B (p=0.000), Group C (p=0.000)].

Table 4: Within Group Analysis of BBS Score

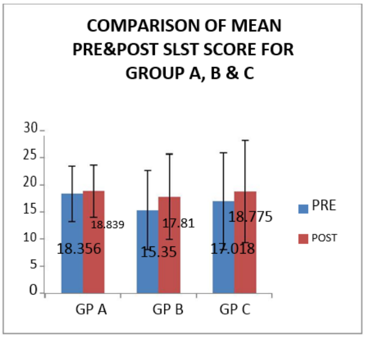
	MEAN		SD		t	P
	PRE	POST	PRE	POST		
GROUPA	51.278	51.611	1.447	1.334	-2.915	.010
GROUP B	51.65	53.25	1.424	1.618	-8.718	.000
GROUP C	51.9	53.05	1.333	1.503	-8.759	.000



For SLST all the groups showed significant statistical difference [Group A (p=0.001), Group B (p=0.000), Group C (p=0.000)].

Table 5: Within Group Analysis of SLST Score

	MEAN		SD		t	P
	PRE	POST	PRE	POST		
GROUPA	18.356	18.839	5.114	4.856	-3.779	.001
GROUP B	15.35	17.81	7.337	7.884	-9.655	.000
GROUP C	17.018	18.775	8.951	9.451	-6.338	.000

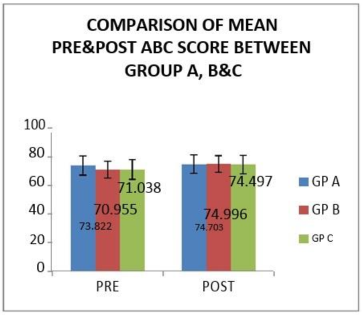


One-way ANOVA was done to compare the data of pre-post values of ABC, BBS, SLST between the groups.

One –way ANOVA on the results of the Activities-specific Balance Confidence (ABC) scale revealed no significant outcome. Participants level of confidence with respect to the risks of falling remained almost similar during the period covered by the study i.e. the score between the groups pre (p=0.272) and post (p=0.964).

Table 6: Between Group Analysis of ABC Score

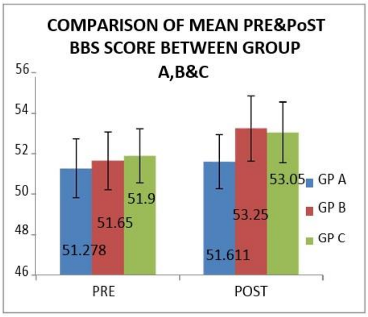
	MEAN			SD			F	P
	GROUP A	GROUP B	GROUP C	GROUP A	GROUP B	GROUP C		
PRE	73.822	70.955	71.038	6.748	5.930	6.846	1.332	.272
POST	74.703	74.996	74.497	6.407	5.753	6.449	.036	.964



One-way ANOVA on the results of the Berg Balance Scale (BBS) between the groups revealed statistical significance difference after post-intervention (p=0.003). But show no significant difference pre-intervention (p=0.385).

Table 7: Between Group Analysis of BBS Score

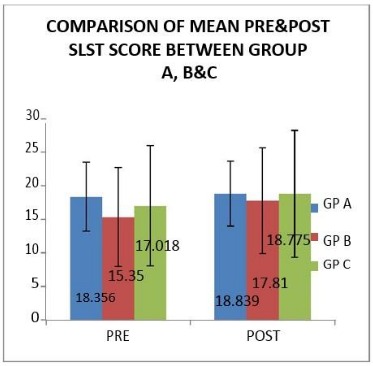
	MEAN			SD			F	P
	GROUP A	GROUP B	GROUP C	GROUP A	GROUP B	GROUP C		
PRE	51.278	51.65	51.9	1.447	1.424	1.333	.972	.385
POST	51.611	53.25	53.05	1.334	1.618	1.503	6.681	.003



Single Limb Stance Test (SLST) score between the groups was not statistically significant pre (p=0.552) and post (p=0.969)

Table 8: Between Group Analysis of SLST Score

	MEAN			SD			F	P
	GROUP A	GROUP B	GROUP C	GROUP A	GROUP B	GROUP C		
PRE	18.356	15.35	17.018	5.114	7.337	8.951	.601	.552
POST	18.839	17.81	18.775	4.856	7.884	9.451	.031	.969



Discussion:

The study was designed to investigate the effect of mental imagery, embedded mental imagery and balance training on geriatric population. The Berg Balance Scale, Activities-specific Balance Confidence Scale, Single Limb Stance Test were used as dependent variables to assess the improvement of balance performance after all training modes, because of the high reliability and prevalence shown in prior balance experiments. In addition, normal healthy participants were the subjects in order to exclude high heterogeneity and its related erroneous interpretation in patients with neurological disorders. Mental imagery training were embedded in physiotherapy, two weeks of mental training resulted in significant improvement in terms even to test the feasibility of supplementing mental imagery training to physiotherapy.[26] Thus, it demonstrate to be practicable for clinical implementation within two week course of outpatient physiotherapy.

All further factors regarding the study intervention remained the same for all groups, except the kind of training programme. Present study shows the fact that embedded mental imagery is an effective therapeutic method for improving the balance control ability of healthy subjects. There may be two possible explanations, First: A physiological mechanism similar to actual movement may occur during mental training. The physiological basis of imagined movements has been subject to several functional neuroimaging studies monitoring changes in cerebral blood flow or oxygenation.[16,3]

The beneficial influence of motor imagery on motor performance has previously been reassessed and confirmed in several experiments, interestingly imagined movements seen to obey the same temporal characteristic and physiological and pathophysiological constraints as executed movement, implying that motor imagery and execution use the same neural representation. According to researcher, when subjects imagined various different type of muscle contraction, a corresponding muscle activation pattern was detected on electromyography. Secondly, the effect of mental training may be explained by cerebral and cerebellar plasticity.[3,14]

Neuroimaging studies using positron emission tomography and functional magnetic resonance imaging techniques demonstrated the most of the regions are active during overt movement execution, such as the parietal and premotor cortex, the basal ganglia, and the cerebellum, are active as well during mental stimulation this suggests that the output produced in the motor and striatal pathways during motor imagery is similar to what is occurring during movement execution.

Therefore, in present study the effect of motor imagery might involve a mechanism similar to physical movement as well as utilization of the neural substrates related to the actual motor function, as the mental imagery was embedded suggesting a direct relationship between the use of mental imagery and the subject improvement in performance.

Concerning the Berg Balance Scale score there was statistically significant inter and group pre-post difference it is interesting to note an increase in post-test of embedded mental imagery group that is clearly differentiated themselves from other groups and there are evidence suggests motor imagery provides additional benefits to conventional physiotherapy or occupational therapy.

Mental practice has been recognized as a complement to physical practice in training motor performance. In a study investigating the effect of age on mental practice, mental practice was found to be beneficial in the acquisition of a bimanual coordination task for children and older adults but not for younger adults. Mental practice facilitated retention of the skill in older adults only, indicating that mental practice was beneficial for older adults, which again correlate with the significant result in embedded mental imagery training group.[22]

According to researcher, a difference of one point range of 56 to54 is associated with 4% decrease in fall risk. Another, para-analytical study found mental practice very effective in facilitating learning tasks requiring much attention or in motor performance. It was emphasized that mental practice wouldn't be effective in improving motor performance and precision unless two factors were included: first, the subject should be somehow skilled before practicing mentally and second, the effective effects of mental practice appear only when physical practice accompany mental practice.[11,2]

Mental rehearsal has been shown to be more beneficial with more complex tasks that involve high cognitive components. Similarly, a study investigating the effects of mental practice on walking balance in elderly women examined reactions on videotaped performance of gait on an activity course. There was no significant difference in walking balance between groups using mentalrehearsal and not using mental rehearsal with hands free, but there was a significant difference in equilibrium reactions when subjects carried objects. This finding indicates that the impact of mental practice increased as the complexity and demand of the gait activity increased. The task performed in present study was complex, requiring significant concentration and the ability both to remember and perform the variations of balance training on the stability trainer and using band. Researcher's in (2001) conjectured the mechanism of action of mental practice as involving minute muscle contractions of the involved muscle in the imagined activity stimulated by impulses from the brain, encoding of the movement patterns within the brain, and by activating, rehearsing, and reinforcing internal imagery thereby proving the efficacy of embedded mental imagery.[22]

Other explanations of the effectiveness of embedded mental imagery in improving motor performance are drawn from the cognitive theories, which state that the mental imagery training allows the individual to develop a precise representation of the behaviour and to program its execution. These mental processes allow the movement to be coded at the central nervous system level and render it more fluid or automatic in nature.[11]

Concerning the inter-group result of Activities-specific Balance Confidence Scale no statistical significant difference were revealed in the present study this may be due to the fact that mental imagery training actually affects the physiological and motor components of an individual and that the effects on their confidence may take longer to appear.

Improvement in Activities-specific Balance Confidence Scale scoring in intra groups post intervention is due to increased body awareness and appreciation of functional deficit which may have been inflated in pre-test. Thereby motivation hypothesis postulates that mental practice increases the subjects motivation to improve.[5]

In mental imagery group there was no statistical significant in inter group pre-post test values of ABC, this may be due to the fact interestingly hypothesised that during motor imagery an excitatory motor command would be paralleled by an inhibitory motor output from the motor cortical areas which actively inhibits the motor effect of the primary motor cortex. An incomplete inhibition would explain the residual electromyographical activation observed during imagery. Its effectiveness is seen when it is combined with other therapeutic intervention.[3]

The goals of balance retraining for older adults should be for remedy or prevent underlying impairments, to develop effective task-specific sensory and motor strategies and to adapt task-specific strategies so that functional tasks can be performed in changing environmental contexts. Therefore several reviews, suggest that balance training should be included in exercise programs recommended to older adults.[25]

It is believed that such repeated, task-specific protocols induce brain reorganization to bring about these functional improvements. The more a person practices a motor task, the more readily it is learned.[31]

It is well established however, that spaced practice (practice with pauses) produce a higher level of task proficiency that practice without pause so further research using controlled rest time needs to be conducted before definitive statements can be made above the effects of sequencing mental practice and physical practice. Investigator have postulated that interspread with physical practice i.e. embedded mental imagery is more effective because it allows kinaesthetic feedback alternated with time for integration and reorganization of movement.[5]

Present study findings may have a practical application to those working in or undergoing rehabilitation. Since, the elderly encounter increased co-morbidities and medical problems with age. Mental rehearsal may be implicated in situations where physical practice is restricted or contraindicated, where safety concerns exit, where assistance for physical practice is needed but unavailable, where there are medical complications, or for an individual who deconditioned and fatigue easily. It could also be employed in the interval between physical therapy sessions or embedded to facilitate retention of novel motor skills.[22]

Mental Practice when combined with physical practice has been shown to increase the accuracy and efficiency of movement at significantly faster rates than physical practice alone. The facilitation of mental practice on skill acquisition has been well documented.[15]

Numerous therapeutic interventions have been attempted in order to improve the postural control ability of elderly adults and various type of patients. Present study shows that embedded mental imagery can provide an effective and safe training method for individuals with balance problems.[11]

Conclusion:

Motor imagery can be seen as a promising technique for motor rehabilitation. Embedded mental imagery appears to be an attractive treatment easy to learn and to apply and believe that mental imagery generate additional benefit for patients when combine with physical intervention and active mental processes. Clinical advantages to administering embedded mental imagery include low cost, group delivery, no equipment needed, and easy incorporation into home programs. Mental imagery potentially is easy to customize for teaching and learning, and to combine with other techniques for general stress reduction, and enables additional practice of motor skill-programming without fatiguing for the user. Since physical practice improves balance, it is assumed also that the application of mental imagery would be useful in enhancing such balance. Motor imagery should reveal itself as a potent tool for probing and possibly improving the functioning of the motor system. The fact that the motor pathways are globally activated during motor imagery represents a rationale for rehearsing effects observed during motor learning and will be a new possibility for rehabilitating patients with motor impairment.

Present study findings shows embedded mental imagery can provide an effective and safe training method for elderly combined with physical training. Other benefits include more focused attention and enhance concentration, greater awareness of self, and improved performance i.e. improvement in balance, which is a fundamental component of human movement, suggests that embedded mental imagery has promising usefulness in health care.

Embedded mental imagery could be a valuable tool for physical therapist to use in helping patients achieve their movement potential.

Limitation:

Study design was of short duration and no home program advised. No follow up was undertaken, to see long term benefits. Other diagnostic technique like Imaging technology (MRI, PET, etc) were not used. Force plate form analysis were not done. Subjects on the basis of gender specific were not taken into consideration.

Future scope of the study:

Further research is necessary to determine the optimum time for the intervention and the duration of the intervention and to analyse the influence of motivation on the efficacy of mental imagery. A clear description of the implemented mental imagery training session elements and temporal parameters would be helpful to interpret study results within available result. In future studies addressing the use of progressive resistance training, it may be prudent to focus on the type of balance to be developed (i.e., static, dynamic, or functional), as well as specific muscle groups to be targeted. Studies with longer duration with follow-up program to assess long term benefits. The study could be done with gender specification. This study can be done with specific age groups.

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REFERENCE:

1. Agnes Zijlstra et al. 2010. "Biofeedback for training balance and mobility tasks in older populations: a systematic review." *Journal of Neuro Engineering and Rehabilitation* 7:58.
2. Ahdiyeh Yadolazadeh, Mehdi Namazizadeh et al. 2010. "The effect of mental practice on muscle electrical activity in force production task." *World Applied Sciences Journal* 11 (8): 970-978.
3. Alfons Schniztler et al. 1997. "Involvement of primary motor cortex in motor imagery: A neuromagnetic study." *Neuroimage* June 201-208.
4. Berg Ko. 1992. "Measuring balance in the elderly." *Canadian Journal Public Health***.**
5. Claudia L Fansler et al. 1995. Effects of mental practice on balance in elderly women, *Journal of the American Physical Therapy Association* 65:1332-1338.
6. Corina, Jenny Butler et al. 2009. "Comparison of embedded and added motor imagery training in patients after stroke: study protocol of a randomised controlled pilot trial using a mixed methods approach." *BioMed Central* 10:97.
7. Edith V. Sullivan et al. 2009. "Postural sway reduction in aging men and women: Relation to brain structure, cognitive status and stabilizing factors." *Neurobiology of Aging* 30: 793-807.
8. Eva V. Monsma et al. 2009. "Psychometric properties of the revised movement imagery questionnaire (MIQ-R)" *Journal of Imagery Research in Sport and Physical Activity*, Article 9, Vol. 4, Issue 1.
9. Fleming Kevin et al. 1995. "Practical functional assessment of elderly persons: A primary-care approach." *Symposium on geriatrics part iii, Mayo Foundation for Medical Education and Research* 1-35.

10. Glenna Batson et al. 2006. "Effect of mental practice combined with physical practice on balance in the community-Dwelling elderly." *Activities, Adaptation & Aging* 31(2).
11. Hamel and Yves Lajoie. 2005. "Mental Imagery. Effects on static balance and attentional demands of the elderly." *Aging Clinical and Experimental Research* 17(3).
12. Hyeong- Dong Kim et al. 2009. "The effectiveness of community-based tai chi training on balance control during stair descent by older adults." *Journal of Physical Therapy Sciences* 21: 317-323.
13. Jackson P et al. 2001. "Potential role of mental practice using motor imagery in neurologic rehabilitation." *Archives of Physical Medicine and Rehabilitation* 82(8): 1133-1139.
14. Jin Ho Choi et al. 2010. "Effect of mental training on the balance control ability of healthy subjects." *Journal of Physical Therapy and Sciences* 22: 51-55.
15. Joyce R Maring. 1990. "Effect of mental practice on rate of skill acquisition." *Physical Therapy* 70:165-172.
16. Katherine Berg et al. 1989. "Measuring balance in the elderly: preliminary development of an instrument." *Physiotherapy Canada*. November/December. 41(6).
17. Kathye-E Light. 1990. "Information processing for motor performance in aging adults." *Physical Therapy* 70(12).
18. Leslie Wolfson et al. 1996. "Balance and strength training in older adults: Intervention gains and tai chi maintenance." *The American Geriatrics Society* 44(5).
19. Ludmina Svetlana M. Calagan et al. 2009. "A systematic review on the effectiveness of mental practice with motor imagery in neurological rehabilitation of stroke patients." *The Internet Journal of Allied Health Sciences and Practice* 2.

20. Marc Jeannerod and Victor Frak. 1999. "Mental imaging of motor activity in humans." *Neurobiology* 9:735-739.
21. Malva S. Freymuth. "Mental practice for musicians: theory and application, *Medical Problems of Performing Artist.*
22. Niamh Tunney et al. 2006. "Mental practice and motor learning of a functional motor task in older adults: A pilot study." *Physical & Occupational Therapy in Geriatrics* 24(3).
23. Olivier A. Hue et al. "Effects of a physical activity program on postural stability in older people." *Aging Clinical and Experimental Research* 16(5).
24. Richard W. Bohannon. 2006. "Single limb stance times a descriptive meta-analysis of data from individuals at least 60 years of age." *Topics in Geriatric Rehabilitation* 22(1): 70-77.
25. Sanna Sihvonen. 2004. "Postural Balance and Aging." *Studies in Sport Physical Education and Health* 101.
26. Schuster et al. 2012. "Comparison of embedded and added motor imagery training in patients after stroke: results of a randomized controlled pilot trial." *BioMed Central* 13:11.
27. Stephen J. Page et al. 2005. "Effects of mental practice on affected limb use and function in chronic stroke." *Arch. Phys. Med. Rehabil.* 86.
28. Th. Mulder. 2007. "Motor imagery and action observation: cognitive tools for rehabilitation." *Journal of Neural Transmission* 114: 1265-1278.
29. Tiago da Silva Alexandre et al. 2009. "Factors associated to quality of life in active elderly. Quality of Life in Active Elderly." Rev Saude Publica.
30. Y. Lajoie et al. 2004. "Predicting falls within the elderly community: comparison of postural sway, reaction time, the Berg balance scale and the Activities-specific balance

confidence scale for comparing fallers and non-fallers." *Archives of Gerontology and Geriatrics* 38: 11-26.

31. Zeynab Taheri et.al. Effect of mental practice on static and dynamic balance in the community-dwelling elderly. *International Journal of Basic Sciences & Applied Research*, 2014 Vol., 3 (7), 386-389