Original Article

EFFECTIVENESS OF GAZE STABILITY EXERCISES ON BALANCE IN HEALTHY ELDERLY POPULATION

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ABSTRACT

Purpose: To determine whether gaze stability exercises are effective in improving the balance disturbance and related confidence in healthy elderly population.
Design: Randomized pre-test and post-test experimental design.
Setting: Superspeciality hospital setup.
Participants: 30 subjects without any definite balance disorder but with history of subjective apprehension attending the outpatient physiotherapy department of BLK Superspeciality hospital, New Delhi, were selected for the study.
Intervention: The experimental group (n=15) performed gaze stability exercises (GSE), and the control group (n=15) performed placebo eye movements. Weekly progression of exercise was done as per the designed exercise protocol. Total time for placebo eye exercises was matched to the time the GSE group spent performing gaze stability exercises. The participants performed the exercises 3 times daily over a 6-week period.
Outcome measures: Participants were evaluated at baseline and after 6 weeks of intervention using the Berg Balance Scale (BBS) and the activities-specific balance confidence scale (ABC) outcome measures for assessing the balance and subjective confidence of balance respectively.
Result: There were no baseline differences (*P* d" .05) between the GSE and CON groups in age and sex, or any outcome measures. GSE group improved significantly in both the outcome measures compared with the control group.
Conclusion: The results of this study suggest us that vestibular-specific gaze stability exercises leads to improvement of balance and subjective confidence to carry out the activities of daily life due to adaptation of VOR reflex in age related vestibulo-ocular reflex degeneration (VOR) found in healthy elderly population.
KEYWORDS: Gaze Stability Exercises, Healthy Elderly Population, Balance, Fall.

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INTRODUCTION

Good balance is an imperative skill for daily life that requires the complex integration of sensory information regarding the position of the body relative to the surroundings and the ability to generate appropriate motor responses to control body movement. Vestibular system is one of the main structures to maintain balance, given that it is considered as an absolute reference in relation to the others that also participate in this function, such as visual and somato-sensorial systems.[1,2]

With increased age, there is a progressive loss of functioning of these systems which can contribute to balance deficits. The healthy elderly individuals are found to have significant impairments in static as well as dynamic balance as compared to healthy young adults[3] as the risk of falls increases beyond 60 years of age.[4] The literature affirms that the vestibulo-ocular reflex

degeneration is the main consequence of natural aging of the vestibular system.[5] The classical manifestation of its failure is unbalance towards body rotation by affecting the act of walking. The intensive training of this reflex, associated to other stimuli, has become efficient to balance recovery and prevention of falls. [6, 7]

Gaze stability exercises (GSE) are the adaptation exercises which are based on the demonstrated ability of the vestibular system to modify the magnitude of the vestibulo-ocular reflex (VOR) in response to a given input (head movement). The adaptation of the VOR has been demonstrated in individuals with normal vestibular function and those with unilateral vestibular hypofunction.[8,9] One of the signals that induce adaptation of the VOR is retinal slip combined with head movement.[10] This is the basis for what have traditionally been considered adaptation exercises. These exercises require the individual to perform rapid, active head rotations while watching a visual target, with the stipulation that the target remains in focus during the head movements.[11]

Oculo-motor exercises and gaze stability exercises are found to be effective for postural stability and dynamic visual acuity (DVA) in healthy young adults.[12] Previous studies have compared subjects who performed vestibular adaptation exercises plus balance and gait exercises to subjects who were simply encouraged to perform their daily activities. These studies included the subjects either with vestibular hypo-function or healthy elderly individuals with nonspecific dizziness.[5,13,14] These studies did not provide any information to identify the necessary component of recommended exercise approaches for improvement in non vestibular balance impairment. It is contended that specific adaptation exercise (gaze stability exercises) can stimulate and modify magnitude of VOR which is a necessary component to work upon as its degeneration is the main consequence of natural aging process. This is hypothesized that a specific therapeutic approach for the vestibular system by the application of gaze stability exercises can be used for improving balance and subjective confidence of balance in healthy elderly population.

METHODS

This study was a randomized pre-test and post-test experimental design. Institute of Applied Medicines and Research, Duhai Ghaziabad (UP) India, ethical committee approved the protocol of the study.

The potential participants were evaluated by a neurologist to assess the integrity of the vestibular and oculomotor systems, and screened for any progressive neurologic problems. Total 30 participants with confirmed normal vestibular functions attending the outpatient physiotherapy department of BLK Superspeciality hospital, New Delhi, were selected on the basics of inclusion and exclusion criteria. Participants were randomly assigned either to Gaze stability exercise group (GSE) or the control group (CON) by using computer generated random number in advance. Participants were blinded for their allocation and each group consisted of 15 subjects. Inclusion criteria included both male and female in the age group of 60 to 70 years with documented balance or mobility problems but have normal vestibular functions and subjective apprehension of loss of balance during activities. Exclusion criteria included Mini-Mental State Examination (MMSE) score <24/30, subjective history of dizziness, progressive medical issues that would affect mobility, presence of neurological, or ENT disorder and any other vascular, metabolic, degenerative or neoplastic disorders, which are confirmedly known to cause balance disorders.

All participants gave informed consent. CON Group received placebo eye movements[14], whereas GSE Group received gaze stability exercises[15] as per the Table 1. Both the exercise protocols were modified in such a way that the total time duration would not exceed more than 30 minutes a day in progression by the 4th week onwards.

The baseline data (Pre test) were measured using BBS[16] and ABC[17] datasheets before commencement of the therapy. These scales have found been found to have good test-retest reliability and validity for balance and reflecting fear of falling and confidence in balance respectively.

Gaze Stability Exercises (GSE)

These exercises require the individual to perform rapid, active head rotations while watching a visual target, with the stipulation that the target remains in focus during the head movements. If the target is stationary, then the exercises are referred to as X1 viewing exercises. If the target is moving in the opposite direction of the head movement, then these exercises are referred to as X2 viewing exercises.

Placebo eye Exercises (CON)

Participants in the CON group performed placebo eye exercises designed to be vestibular neutral. The CON group performed saccadic eye movements without visual targets against a plain white wall while keeping the head stationary.

Weekly progression of exercises for both the groups was done as per the Table1. Total time for eye exercises was matched to the time the GSE group spent performing gaze stability exercises.

All participants were instructed to come back to department on a weekly basis to review and update their exercise program, and they were taught an exercise program that they were to follow at home. The participants were instructed to perform the exercises 3 times daily over a 6-week period. After 6th week, post intervention data was collected again to analyze the statistical differences.

Data analysis

Continuous and dichotomous demographic variables (Age and gender respectively) of two groups (Control and Experimental) were compared by independent t test. The change score between the pre and post treatment balance outcome measures (i.e BBS &ABC) of two groups were compared by independent t-test. The pre post difference within the group was analyzed using paired t test. A two-tailed ($\alpha = 2$) probability (p) value $p<0.05$ was considered to be statistically significant.

RESULTS AND TABLES

The basic characteristics of participants at baseline assessment are summarized in Table2. There were no baseline group differences

($P \geq .05$) in age and gender. There were no baseline group differences in any outcome measures ($P \geq .05$; Table 3).

Table 2: Demographic characteristics summary (Mean ± SD, n=15) of two groups.

S.NO.	Characteristics	Groups		p value
		Control(CON)	Experimental(GS)	
1	Sex: M/F (no)	7/8	6/9	0.724
2	Age (yrs)	64.60 ± 2.55	65.80± 3.27	0.273

Table 1: Exercise Protocols.

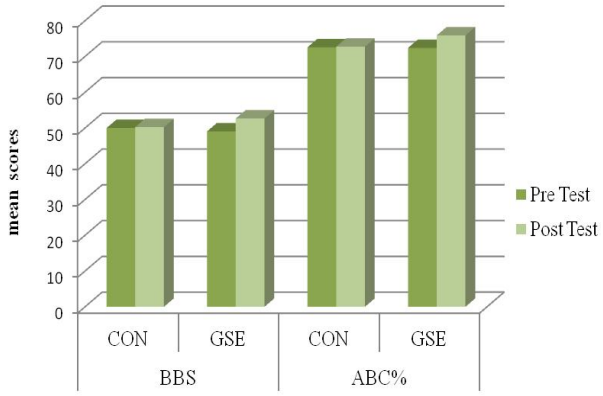
Weeks	Gaze stabilization exercises (GS)[17]	Placebo eye movements (CON)[15]	Duration (min)	Frequency (per day)	Total (min)
1	Horizontal and vertical X1 viewing exercise with near target, sitting	Saccadic eye movements, no target, distant/ near, horizontal/ vertical, sitting	1	3 Times	6
2	Horizontal and vertical X1 viewing exercise with near and far targets, sitting	Saccadic eye movements, no target,near, horizontal/ vertical/diagonal; sitting Saccadic eye movements, no target,distant, horizontal/ vertical/diagonal; sitting	2	3 Times	12
3	Horizontal and vertical X1 viewing exercise with near and far target, standing	Saccadic eye movements, no target, distant/ near, horizontal/ vertical/diagonal; standing	2	3 Times	24
4	Horizontal and vertical X1 viewing exercise with near and far target, and targets located in front of busy background, standing	Saccadic eye movements, no target, distant/ near, horizontal/ vertical/diagonal, standing	2	3 Times	30
5	Horizontal and vertical X1 viewing exercise with near and far target, and targets located in front of busy backg round. Horizontal and vertical X2 viewing exercise, plain background, Standing.	Saccadic eye movements, no target, distant/ near, horizontal/ vertical/diagonal, standing	1	3 Times	30
6	Horizontal and vertical X1 viewing exercise with near and far target, and targets located in front of busy background. Horizontal and vertical X2 viewing exercise, plain background, Standing.	Saccadic eye movements, no target, distant/ near, horizontal/ vertical/diagonal, standing	1	3 Times	30

Table 3: The pre and post treatment measuring outcomes (Mean ± SD, n=15) of two groups.

	Groups	Periods		P value[a]
		Pre test	Post test	
BBS	Control(CON)	50.00± 2.36	50.26± 2.37	0.103
	Experimental(GS)	49.06± 2.49	52.66± 1.83	0
P value[b]		0.301	0.004	
ABC	Control(CON)	72.58± 3.15	72.75± 3.17	0.164
	Experimental(GS)	72.41± 3.18	75.91± 3.07	0
P value[b]		0.886	0.01	

*P value[a] indicates the pre post difference within the group whereas P value[b] indicates comparison between the groups at pre test as well as post test levels. A two-tailed (á=2) probability (p) value p<0.05 was considered to be statistically significant.

Fig. 1: The pre and post treatment measuring outcomes (Mean ± SD, n=15) of two groups.



On comparing the BBS and ABC scores between the groups at pre test did not differ significantly ($P \geq .05$) i.e. found to be statistically the same. Similarly, comparing all the outcome measures within the groups, GSE group showed significant increase in mean scores at post test as compared to pre test whereas mean change of these scores in control group was found to be insignificant. On comparing these scores between the groups, the mean change differed significantly (p<0.05) as shown in table 3 and figure 1.

DISCUSSION

The results of this study indicate that GSE group improved significantly in balance measured with BBS and ABC outcomes measures whereas no significant differences were found in balance scores of the control group. Though the participants in this study were found to have the less risk of fall based on the BBS baseline scores but were found to have marked loss of confidence in balance in carrying out the activities of daily life. This suggest that even the statistical meaningless baseline BBS scoring and small magnitude change at post intervention is capable of reducing the psychological impact of balance impairment in healthy elderly individuals.

The recommended protocols for Vestibular Rehabilitation of elderly patients consist of global stimulation of the balance which is based on exercises of substitution, adaptation and habituation. These exercises are based on the physiopathology of unbalance that affects the elderly caused by the aging process of the sensory systems and muscle-skeletal efectors.[18,11] However, these alterations begin by the aging process of the vestibular system, whose main consequence is the vestibulo-ocular reflex degeneration (VOR)[5] which leads to the unbalance towards body rotation and a deviation on the walking act. Based on all this information, the efficiency of use of specific exercises for the VOR adaptation was verified and it was observed that it had been equally effective as the long protocols of global stimulation, in this age.[7]

It was reported that decreased angular head velocities improve target stabilization on the retina. Further, it was also suggested that this may begin to explain the head-trunk segmental stiffening observed in the elderly, since it may act to decrease head angular velocity during fall and subsequent balance recovery.[19] Based on this information it may be assumed that significant improvement in experimental group might be because of another probability that participants in the GSE group do have an element of head movements to make them more accustomed to head movements with better control and stability of head-trunk segment.

The study by Courtney D. Hall et al[14] provides evidence that in older adults with symptoms of dizziness and no documented vestibular deficits, the addition of vestibular-specific gaze stability exercises to standard balance rehabilitation results in greater reduction in fall risk. Altogether, the intensive training of this reflex, together with other stimuli, has been presenting efficiency for both balance recovery and fall prevention.[6]

Further, results of this study fall in accordance with the suggested efficacy of specific type of vestibular (gaze stability exercises) and ocular

system exercises (oculo-motor exercises) in improving postural stability for healthy young adults too.[12]

One possible mechanism leading to differential improvement is the adaptation of the vestibulo-ocular reflex through performance of specific vestibular exercises. These improvements may be largely due to the learning and practice effects associated with the intervention in the GSE group.

Clinical significance

The easiness on performing VOR exercises is one favorable aspect when training the elderly, who may present difficulties in understanding the exercises. The gaze stability exercises may be preferentially included in the balance rehabilitation of the healthy older adults because it can be performed in the home, especially when patients are not able to come for regular outpatient therapy.

CONCLUSION

Gaze stability exercises are effective in improving balance and reducing the psychological impact of balance impairment in healthy elderly adult population.

Limitations

This study has certain limitations like, in order to achieve more reliability on the quantity findings from the posturography examination may provide a more accurate data as it is believed that the head and body alignment is an important factor to expand the limits of body stability. Moreover, measures such as, functional and community ambulation balance, and quality of life may also be assessed to study the effect of the experimental intervention in healthy elderly population. A follow-up study to find out the long-term effects of gaze stability exercises in healthy older adult subjects may be beneficial in promoting the restoration of mobility and independence of subjects.

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