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The effect of gaze stability exercises on balance and gait in elderly population-A comparative study

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Abstract
Aim: The Aim of this study is to compare the effect of Gaze Stability Exercises and Placebo Eye Movements in Improving balance, confidence and gait among elderly population.
Materials and Methods: A Quasi Experimental study design consisting of reviews of charts healthy elderly population. Thirty persons were included, (60%) were females, (40%) were males; the average age was 66 years. All of them are presented with balance disorders, loss of confidence and gait abnormalities. Pre- and post-Treatment of (GSE) and (PE) scores on the severity of balance, functional activities and gait were analyzed by the BBS, ABC and TUG.
Results: The pre and post-test values were assessed by BBS, ABC and TUG in Group A and Group B. The Calculated 't' values by Unpaired 't' test of BBS is 10.81, ABC is 9.61, and TUG is 7.81 respectively The calculated 't' values were more than the table value 2.05 for 5% level of significance at 28 degrees of freedom.
Conclusion: In the present sample, Gaze Stability Exercises had a positive and significant effect on balance, confidence and gait among the elderly population and also it increases the quality of life in elderly, as measured by the BBS, ABC and TUG scores before and after therapy.

Keywords: gaze stability exercises (GSE), placebo eye exercise (PE), berg balance scale (BBS), The activities-specific balance confidence (ABC) scale, time up and go test (TUG)

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.

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 as the risk of falls increases beyond 60 years of age. The literature affirms that the vestibulo-ocular reflex degeneration is the main consequence of natural aging of the vestibular system. 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.

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. One of the signals that induce adaptation of the VOR is retinal slip combined with head movement. 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.

Oculo-motor exercises and gaze stability exercises are found to be effective for postural stability and dynamic visual acuity (DVA) in healthy young adults. There are many 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. 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.

Methodology

Thirty patients of both sexes their ages above from 60 -70 years of healthy elderly population were selected randomly where the study was conducted. Patient's demographic data, clinical characteristic and all medical history was collected to ensure that all patients were clinically and medically stable. The study was conducted at Home for Elderly people at Erode. The duration of the study period is for 8 months. They were assigned into two groups with equal numbers whereas Group A underwent Gaze Stability Exercises (GSE) once in a day for 30 mins for 6 weeks. Group B underwent Placebo Eye Exercises once in a day for 30 mins for 6 weeks.

Patients who had met one of the following criteria were excluded from the study; that is 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. The following Parameters were used to assesses their abilities.

Parameters

Berg Balance Scale

The Berg Balance Scale (or BBS) is a widely used clinical test of a person's static and dynamic balance abilities, named after Katherine Berg, one of the developers. For functional balance tests, the BBS is generally considered to be the gold standard.

Activities-Specific Balance Confidence Scale (ABC)

16-item self-report measure in which patients rate their balance confidence for performing activities. This stem is used to lead into each activity considered: "How confident are you that you will not lose your balance or become unsteady when you..." Items are rated on a rating scale that ranges from 0 - 100.

Time Up and Go Test

The Timed Up and Go test (TUG) is a simple test used to assess a person's mobility and requires both static and dynamic balance. It uses the time that a person takes to rise from a chair, walk three metres, turn around, walk back to the chair, and sit down.

The BBS, ABC and TUG test is conducted to confirm diagnose of balance, confidence and gait among elderly patients.

Procedure

Table 1: [gaze stability exercises and placebo eye movements]

Weeks	Gaze Stabilization Exercises (GSE)	Placebo Eye movements	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	3times	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 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
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

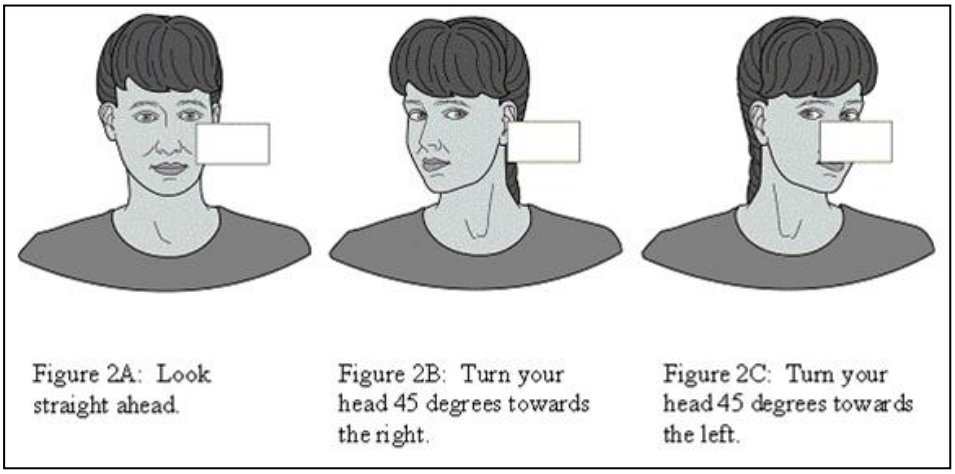

Figure 2A: Look straight ahead.

Figure 2B: Turn your head 45 degrees towards the right.

Figure 2C: Turn your head 45 degrees towards the left.

Fig 1

Exercise dimensions -- how exercises are made more complex and difficult

1. **Protocol of head movement**

- Head turn with pause (head thrusts, may be very fast)
- Head turn back and forth continuously without pause (sinusoidal, generally slow and medium only)
- Occasionally, one adds in linear movement (these are angular movements) such as sitting on a "bouncy ball". These types of movements are sometimes important to driving.

2. **Speed of head movement -- you want to practice all of these --no just the fast one.**

- Slow
- Medium
- Fast (also called a head thrust)

3. **Target distance while moving head --this is to change demands for otolithic participation**

- Near (1 foot)
- Far (3 feet or greater)

4. Background while moving head -- this is to practice multisensory integration. Very important.

- Eyes closed (this is for practice of mental imagery)
- blank background
- busy background (i.e. checkerboard)
- Very busy background (i.e. grocery store)
- Very busy moving background (i.e. crowds, windy outdoors, watching waves come in)
- Misleading background (i.e. rotating visual surround, twisting golf umbrella, walking against a crowd moving the other direction, x2 exercises - -where head and target move in different directions)

5. **Head position on trunk -- this is to avoid training for a single context. *This may not be the most important dimension unless you spend a lot of time with your head off center.***

- Middle
- Left and right
- Up and down
- Roll (movement of head around front-back axis)

6. **Head position with respect to gravity -- to avoid training for a single context. *This is not the most important dimension unless you need to have good balance in odd positions.***

- Upright
- Supine
- Prone

7. **Other things going on that require mental processing by themselves. T*his is where things can get really hard, when combined with some of the other activities above.***

- Movement such as walking -- outdoors is best, but a treadmill is another possibility.
- Thinking/talking on your cell phone/driving

Data Presentation and Statistical Analysis

The statistical tools used in the study are paired t-test and unpaired t-test. The paired t-test was used to find out the statistical significance between pre and post t-test values before and after treatment for Group A and Group

B. The unpaired t-test was used to compare the statistically significance difference of BBS, ABC and TUG for Group A and Group B before and after treatment.

Table 2: Comparison of Mean Difference, SD and Paired 't' test value of BBS, ABC and TUG

Parameters	Mean Difference		Standard Deveiation		Paired 't' Test Value	
	Group A	Group B	Group A	Group B	Group A	Group B
BBG	31	19	2.42	1.62	48.67	43.75
ABC	59	45	3.0	2.2	74.73	72.54
TUG	42	37	1.30	1.14	126.61	122.70

Table 3: Comparison of Unpaired 't' test and Table Value between BBS, ABC and TUG

Parameters	Unpaired 't' TEST	Table Value	Significance
BBS	10.81	2.05	Significant
ABC	9.65	2.05	Significant
TUG	7.81	2.05	Significant

Graphical representation of the parameters

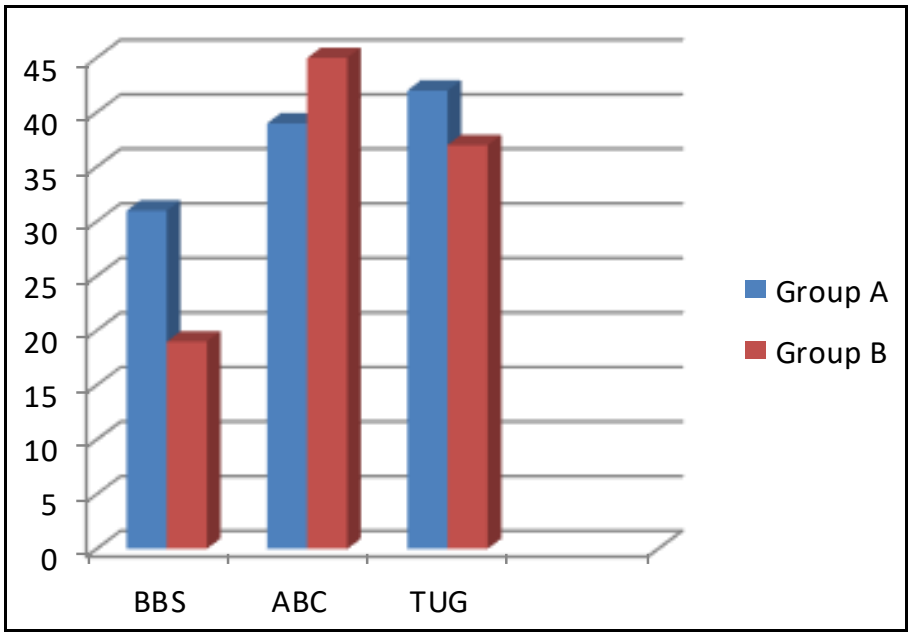

Fig 2: Mean Difference of BBS, ABC and TUG

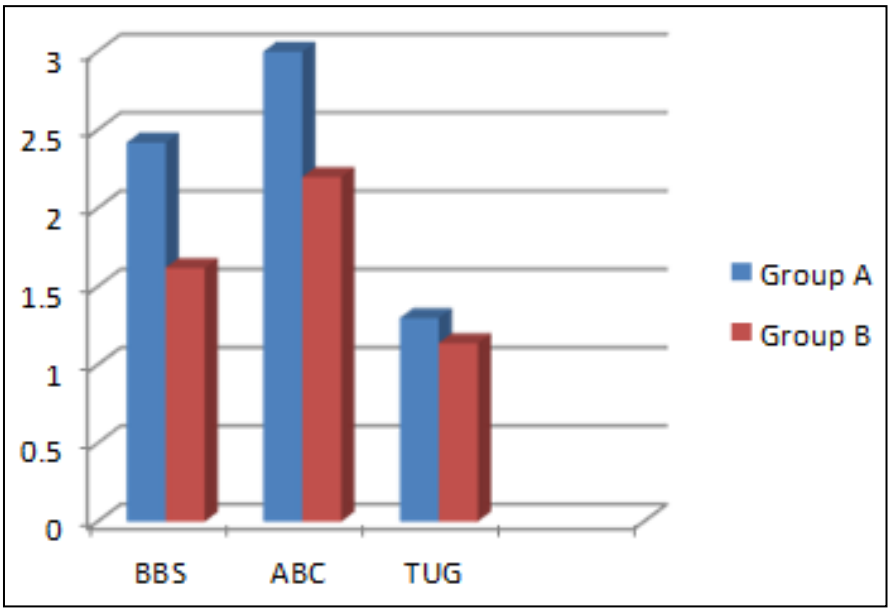

Fig 3: Standard Deviation of BBS, ABC and TUG

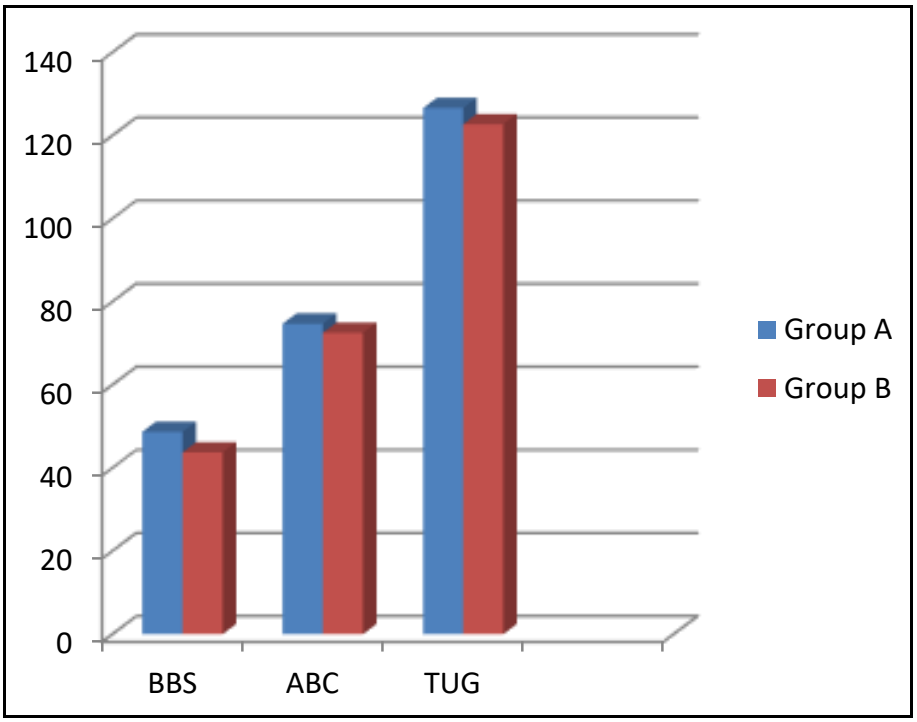

Fig 4: Paired 't' test value of BBS, ABC and TUG

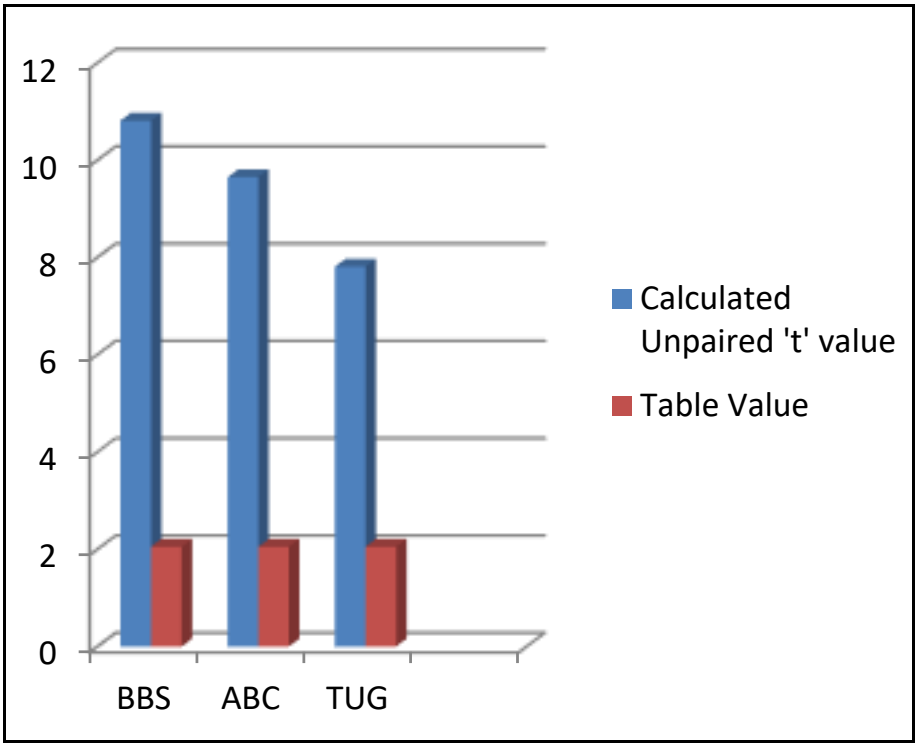

Fig 5: Comparison of Unpaired 't' test and table Value

Results

The study sample comprised 30 patients, of which 20 were male and 10 were female. The mean age of patients was 66 years. The median time interval between BBS, ABC and TUG assessment is applied before and after therapy was 6 weeks. Among 30 patients, 15 were treated with Gaze Stability Exercises, and 15 were treated with placebo eye exercises.

The pre and post-test values were assessed by BBS, ABC and TUG in group A and group B. The mean difference value of BBG is 31 and 19, ABC is 59 and 45, and TUG is 42 and 37 respectively. The standard deviation of BBG is 2.42 and 1.62, ABC is 3.0 and 2.2 and TUG is 1.30 and 1.14 respectively. The Paired 't' value of BBS is 48.69 and 43.75, ABC is 74.73 and 72.54, and TUG is 126.61 and 122.70 respectively. The Paired 't' test value is more than table value 2.15 for 5% level of significance at 14 degrees of freedom.

The Calculated 't' values by unpaired 't' test of BBS is 10.81, ABC is 9.61, and TUG is 7.81 respectively The calculated 't' values were more than the table value 2.05 for 5% level of significance at 28 degrees of freedom.

The Paired 't' test values have shown that Gaze Stabilization Exercises was more effective than Placebo Eye exercises in improving balance, confidence and gait in elderly population. The Unpaired 't' test values have shown that there was significant difference between two groups in showing improvement in their quality of life in elderly population.

Discussion

The results of this study indicate that GSE group improved significantly in balance measured with BBS, ABC and TUG 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. And also there is marked improvement in gait. 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 and also improves the gait in 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 effectors. However, these alterations begin by the aging process of the vestibular system, whose main consequence is the vestibulo-ocular reflex degeneration (VOR) 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.

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. 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* 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. 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. One possible mechanism leading to differential improvement is the adaptation of the vestibule 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.

This study has proved that Gaze Stability Exercises is more effective.

Summary and Conclusion

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

The results of this study suggest us that vestibular-specific gaze stability exercises leads to improvement of balance, gait 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.

Through the resuts, alternate hypothesis is accepted and also the study could be concluded that there is a significant difference in Gaze Stability Exercises in improving Balance, Functional Confidence and Gait in elderly population.

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