A Study to Compare the Effect of Balance Training Exercises on Presbystasis: A Cross-Sectional Study

Snehil Verma¹, Ashutosh Sharma², Anita Bhandari³, Atul Singh⁴, Punam Chandra⁵

¹MPT, Neurology and Psychosomatic disorders, Jaipur National University, Jaipur, Rajasthan, India.
²Associate Professor, Department of Physiotherapy, Jaipur National University, India.
³Clinical Neurotologist, Vertigo and Ear Clinic, Jaipur.
⁴Associate Professor and HOD, Department of Physiotherapy, Jaipur National University, India.
⁵Assistant Professor, Department of Physiotherapy, Jaipur National University, India.

ABSTRACT
BACKGROUND OF THE STUDY
Presbyastasis is a medical term for age related balance problems. Presby means elders and stasis means balance problem. Presbyastasis can be defined as an aging disequilibrium. Elderly people often complain of dizziness and loss of balance. The main sign and symptoms of presbyastasis are dizziness, loss of balance, increased fall risk, vertigo, postural instability which progressively increases loss of quality of life. An estimated 13 percent of adults report imbalance between the ages of 65 and 69. For people 85 and older, it increases to 46%. In addition, balance, and gait disorders are associated with an increased risk of falls13. The estimated annual fall rate for adults over age 65 is 28%. Balance is important for maintaining postural balance and thus preventing falls.

PURPOSE OF THE STUDY
The purpose of this study is to observe the comparison of the effect of the rhythmic weight shift exercises and limit of stability exercises on balance and fall risk in patients with presbystasis.

STUDY DESIGN
A Cross-sectional study.

METHODOLOGY
Individuals suffering with presbystasis, between the age group 65 to 85 were included in this study. Presbystasis should be confirmed diagnosed by ENT physician with posturography and Cranioceprography done of the patients, showing abnormal sway were considered in this study. Intervention done are Rhythmic weight shift exercises and Limit of stability exercise protocol. Outcome measures used were FHI scale and TUG test to measure pre-test and post-test scores. Intervention was given for 4 weeks, with 4 sessions per week.
RESULT
Descriptive statistical analysis has been carried out in the present study. Results on continuous measurement are presented on mean and standard deviation. Paired t-test was used to compare the changes in the balance & risk of fall within the groups and independent t-test was used to compare baseline values between the group measures of balance & risk of fall & handicap among the participants of Group A and B. Both the groups showed significant improvement in balance and fall risk, but group B shows better improvement than group A, suggesting better clinical outcomes in those treated with Limit of stability exercise protocol.

CONCLUSION
The study concluded that Rhythmic weight shift and Limit of stability exercises are both effective in reducing falls and improving balance in patients with presbystasis. But the participants of group B, who have received Limit of stability exercise protocol have better clinical outcomes when compares the FHI and TUG score of both groups.

KEYWORDS: Presbystasis, Balance training, Rhythmic weight shift, Limit of stability, Dizziness, Disequilibrium.

1. INTRODUCTION
Life expectancy is increasing worldwide, especially in the Indian subcontinents. The problems associated with ageing are now understood as the proportion of the population in this category is increasing\(^1\). The number of people aged 65 and over continues to grow at an unprecedented rate. India’s current population is 1.41 billion as of Tuesday, January 31, 2023 based on the latest UN data Worldometer revision. India’s elderly population is now the world’s first largest. With the rapid aging population, it is important to emphasize the need to maintain function and maintain quality of life into old age. There are an estimated 962 million people over the age 60 in the world, representing over 13% of the total population.

Age related changes in vestibular function include a decline in vestibulo-ocular reflex, which is responsible for stabilizing vision during head movements, as well as the vestibulospinal reflexes, which is used to maintain upright posture\(^3\).

Balance and gait are important considerations in the health of the elderly. Maintaining balance depends on the information the brain receives from the three organs: eye, muscles and joints, and vestibular system. All three of these sources send signals to the brain in the form of nerve impulses to certain nerve terminals called sensory receptors. An estimated 13 percent of adults report imbalance between the ages of 65 and 69. For people 85 and older, it increases to 46%. \(^4\) The prevalence of walking disorder among community-dwelling adults 70 years and older has been estimated 35% in elderly.

Falls are associated with significant morbidity and mortality in the elderly: they are the most common cause of accidental death and nonfatal accidental injury in those 65 and older, accounting for 55.8% of accidental deaths\(^4,5,6,7,8\). One study reported that more than 10,000 seniors died from accidental falls 65 and older every year, and the risk increases with age\(^9\). Impaired postural stability is recognized as a major risk factor for falls in the elderly\(^10\). Some fall risk factors are irreversible, while others are potentially modifiable with appropriate interventions\(^11\). Balance is important for maintaining postural balance and thus preventing falls.

According to WHO fall is defined as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level\(^12\). Many people who experience falls are immobilized by fear...
of falling, which in turn increases the risk of pressure ulcers, pneumonia, weakness, and falls\textsuperscript{13} The presence of dizziness in elderly is a strong augury of fall. Dizziness is a frequent occurrence in the elderly and it carries substantial health and quality of life consequences for elders\textsuperscript{14}. Multifactorial balance dysfunction and dizziness that occur in an individual age is also called Presbyastasis\textsuperscript{15}.

Presbyastasis is a medical term for age related balance problems. Presby means elders and stasis means balance problem\textsuperscript{16}. Presbystasis can be defined as an aging disequilibrium. It is dizziness and imbalance caused by the aging of the sensory systems, the aging of the central nervous system and motor system\textsuperscript{15}. Elderly people often complain of dizziness and loss of balance. Elderly people with dizziness are found to have significant disabilities that require assistance. According to Agrawal et al., the likelihood of falling increases 12-fold in people affected by vestibular dysfunction\textsuperscript{17}. Age-related vestibular degeneration is a condition that leads to unsteady gait, dizziness, and an increased risk of falling in the elderly which interferes with daily activities and life.

Presbyastasis summarizes these terms and can be defined as an age-related imbalance of peripheral and central balance systems (vestibular, visual, somatosensory) involved in striking the right balance\textsuperscript{18}. The main sign and symptoms of presbyastasis are dizziness, loss of balance, increased fall risk, vertigo, postural instability which progressively increases loss of quality of life\textsuperscript{2,16}. People who suffer with other vestibular conditions are more prone to Presbyastasis. Age related conditions of reduced vestibular functions that can manifest in the elderly increases the chances of presbyastasis\textsuperscript{19}.

Vestibular rehabilitation therapy (VRT) is a specialized treatment primarily aimed at reducing problems caused by vestibular disorders such as dizziness and vertigo, gaze instability and/or loss of balance and falls\textsuperscript{20}. People with vestibular disorders often experience problems such as dizziness, vertigo, visual disturbances, and/or imbalance\textsuperscript{21}. VR aims to use a problem-oriented approach to facilitate compensation\textsuperscript{22}. This is done by customizing exercises to address each individual's specific problems. Depending on the identified vestibular problem, three main exercise strategies can be prescribed: 1) habituation, 2) gaze fixation, and/or 3) balance training\textsuperscript{24}.

2. METHOD and METHODOLOGY
This study is a prospective cross-sectional study, and the subject were recruited from a tertiary Neurootology Clinic. Participants who fulfil the inclusion criteria were included in the study. The purpose of the study was explained to the subjects. And the participants were instructed regarding treatment protocol in detail. The written consent was taken from the subjects before starting the treatment protocol. Patients with presbyastasis randomly assigned into 2 groups; Group A and Group B. Subjects fill the FHI questionnaire and TUG test was done.

The following protocol was followed:
1. Individuals with confirmed diagnosis of Presbyastasis by ENT physician.
2. Craniocorpography (CCG) showing abnormal sway in any 2 components of CCGi.e., Unterberger test, Romberg test and tandem walking.
3. Posturography showing abnormal sway.
• After getting the results of these test the patients will be randomly allocated to one of the 2 experimental groups, with 25 patients in each group.
  GROUP A: - Rhythmic Weight shift exercises
  This group consist of 25 participants. They were treated with the Rhythmic Weight shift exercise protocol.
  GROUP B: - Limit of Stability exercises.
  This group consist of 25 participants. They were treated with the Limit of Stability exercise protocol.
• For both the groups, interventions are given for 4 sessions per week, for 4 weeks, and the data was collected on day 0 and day 28.

DATA ANALYSIS
Data analysis was accomplished with following software: Microsoft EXCEL (Professional Edition 2007; Microsoft Corp, Redmond, WA) and Statistical Package of Social Sciences (SPSS version 20). Paired t-test (parametric test) was used to compare the changes in the balance & risk of fall within the groups and independent t-test was used to compare baseline values of age, balance & risk of fall & handicap and also the final between the group measures of balance & risk of fall & handicap among the participants of Group A and B. A statistically significant difference was defined as ‘p’ value was less than 0.005.

RESULT
DESCRIPTIVE ANALYSIS
1. Demographic Data:
A total of 50 participants volunteered for this study. 26 males and 24 females participated in the study (Group A: 13 males and 12 females; Group B: 13 males and 12 females). The mean age in the Group A and Group B were 71.48±3.917 and 73.72±3.422 respectively. Table gives the details of mean and standard deviation of this data.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>S.D.</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>71.48</td>
<td>3.917</td>
<td>0.03</td>
</tr>
<tr>
<td>Group B</td>
<td>73.72</td>
<td>3.422</td>
<td></td>
</tr>
</tbody>
</table>

Graph 1: Bar graph representing mean and standard deviation of age of the participants of Group A and
2. **Baseline Parameters:**

The Timed Up & Go (TUG) is the measure of extent of Balance & Risk of fall, Fall Handicap Inventory (FHI) is the measure of handicap associated falls. The pre-test means values for TUG for participants in the Group A & B came out to be 31.4±3.367 and 31.80±2.466 respectively; that of FHI came out to be 52.80±4.143 & 52.60±3.797. Between the group comparison of baseline parameters was conducted using independent t-test test, with level of significance, p set at 0.05. The comparison of the readings for Group A and B was not found to be statistically significant (0.0001). This validates the normalization of the baseline variables.

**Table 2:** Mean and standard deviation of Timed Up & Go & FHI of Group A and Group B

<table>
<thead>
<tr>
<th></th>
<th>TUG</th>
<th>FHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>31.4±3.367</td>
<td>52.80±4.143</td>
</tr>
<tr>
<td>Group B</td>
<td>31.80±2.466</td>
<td>52.60±3.797</td>
</tr>
<tr>
<td>P value</td>
<td>0.634</td>
<td>0.860</td>
</tr>
</tbody>
</table>

**Graph 2:** Bar graph representing mean and standard deviation of TUG of the participants of Group A and Group B.
Graph 3: Bar graph representing mean and standard deviation of FHI of the participants of Group A and Group B.

Within The Group Comparison

1. Balance & Risk of Fall:
The Timed Up & Go (TUG) is the measure of extent of Balance & Risk of fall. The pre-test and post-test mean values for Timed Up & Go for participants in the Group A came out to be 31.4±3.367 and 15.04±1.989 and that for Group B came out to be 31.8±2.466 and 11.76±1.332. Within the group analysis of TUG was conducted using Paired t-test, with level of significance, p set at 0.05. The comparison of the readings for TUG of the two groups namely, Group A and B was found to be statistically significant (0.0001).

<table>
<thead>
<tr>
<th></th>
<th>Pre-Test</th>
<th>Post-Test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>31.4±3.367</td>
<td>15.04±1.989</td>
<td>0.000*</td>
</tr>
<tr>
<td>Group B</td>
<td>31.8±2.466</td>
<td>11.76±1.332</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

Table 3: Mean and standard deviation of Timed Up & Go of Group A and Group B.

Graph 4: Bar graph representing mean and standard deviation of Timed Up & Go of the participants of Group A
Graph 5: Bar graph representing mean and standard deviation of Timed Up & Go of the participants of Group B

2. Fall Handicap Inventory (FHI):
The Fall Handicap Inventory (FHI) is the measure of extent of handicap associated with repeated falls. The pre-test and post-test mean values for FHI for participants in the Group A came out to be 52.8±4.143 and 25.12±2.386 and that for Group B came out to be 52.6±3.797 and 16.16±3.508.

Within the group analysis of FHI was conducted using Paired t-test test, with level of significance, p set at 0.05. The comparison of the readings for FHI of the two groups namely, Group A and B was found to be statistically significant (0.0001).

Table 4: Mean and standard deviation of FHI for Group A and Group B

<table>
<thead>
<tr>
<th></th>
<th>Pre-Test</th>
<th>Post-Test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>52.8±4.143</td>
<td>25.12±2.386</td>
<td>0.000*</td>
</tr>
<tr>
<td>Group B</td>
<td>52.6±3.797</td>
<td>16.16±3.508</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

Graph 6: Bar graph representing mean and standard deviation of FHI of the participants of Group A.
**BETWEEN THE GROUP COMPARISON OF TIMED UP & GO & FALLHANDICAP INVENTORY**

1. **Balance & Risk of Fall**

   The Timed Up & Go (TUG) is the measure of extent of Balance & Risk of Fall. The post-test mean values for TUG for participants in the Group A came out to be 15.04±1.989 and that for Group B came out to be 11.76±1.332.

   Between the group analysis of TUG was conducted using Independent t-test test, with level of significance, p set at 0.05. The comparison of the readings for TUG of the two groups namely, Group A and B was not found to be statistically significant (0.0001).

   **Table 5:** Mean and standard deviation of Timed Up & Go of Group A and Group B

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean±SD</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>15.04±1.989</td>
<td>0.000</td>
</tr>
<tr>
<td>Group B</td>
<td>11.76±1.332</td>
<td></td>
</tr>
</tbody>
</table>

   **Graph 8:** Bar graph representing mean and standard deviation of TUG of the participants of Group A and Group B.
2. Fall Handicap Inventory (FHI)
The Fall Handicap Inventory (FHI) is the measure of handicapped associated with repeated falls. It is measured using a self-administered 18 item scale. The post-test mean values for FHI for participants in the Group A came out to be 25.12±2.386 and that for Group B came out to be 16.16±3.508.

Between the group analysis of FHI was conducted using Paired t-test test, with level of significance, p set at 0.05. The comparison of the readings for FHI of the two groups namely, Group A and B was not found to be statistically significant (0.0001).

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Group A</td>
<td>25.12±2.386</td>
<td>0.000</td>
</tr>
<tr>
<td>Group B</td>
<td>16.16±3.508</td>
<td></td>
</tr>
</tbody>
</table>

Graph 9: Bar graph representing mean and standard deviation of FHI of the participants of Group A and Group B.

DISCUSSION
In this prospective study we tried to evaluate presbystasis patients and assess the effect of balance training exercises on fall efficacy and dizziness. This study also compares the two balance training approaches that is Rhythmic weight shift and limit of stability. The study was carried out at a tertiary Neuro-Otology clinic. 50 patients between the age group of 65 to 80 years of age were included in this study. Our overall result agrees with those reported in the literature that the balance training exercises are helpful in decreasing the falls in older adults and improves the ADL and confidence.

Both the groups showed significant improvement in balance and fall risk, but group B shows better improvement than group A, suggesting better clinical outcomes in those treated with Limit of stability exercise protocol.
CONCLUSION
The study concluded that Rhythmic weight shift and Limit of stability exercises are both effective in reducing falls and improving balance in patients with presbystasis. But the participants of group B, who have received Limit of stability exercise protocol have better clinical outcomes when compares the FHI and TUG score of both groups. Hence, we concluded and accepted the experimental hypothesis which stated that Limit of stability exercises have a significant effect in balance and fall in individuals having presbystasis.

CONFLICT OF INTEREST
Author declares no conflict of interest.

ACKNOWLEDGEMENT
Dedicated to my beloved Parents Mrs. Ranno Devi and Mr. Kamlesh Kumar Verma.

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