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Effect of Proprioceptive Exercise Program versus Vestibular Rehabilitation Therapy on Risk of Fall in Elderly

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ABSTRACT

Background: Fall is considered to be major contributing factor resulting in serious injuries with increased morbidity and mortality in elderly population.
Objective: This study was done to evaluate the effect of proprioceptive exercises and vestibular rehabilitation on risk of fall in elderly.
Methods: A survey was carried out on 100 elderly individuals across Senior Citizen Club to evaluate risk of fall in elderly. Amongst these, 60 patients were selected based on inclusion and exclusion criteria and were further randomly divided into Group A (n=30,age 68.4±3.54) which received Proprioceptive training and Group B (n=30, age 68.53±2.99) which received Vestibular training. Patients were evaluated pre and post intervention for risk of fall using Berg Balance Scale, Time Up and Go Test, Fall Efficacy Test, and Functional Reach-out Test.
Result: Between group comparison showed significance improvement in Berg Balance Scale from (35.2± 12.03) to (42.7±11.03), Time Up And Go Test from (17.6±2.29) to (12.9±1.98), Fall Efficacy Test from (36.9±13.3) to (25.8±9), and Functional Reach Out Test from (20.12±4.7) to (23.0±4.73) for Group A as compared to Berg Balance Scale from (34.7±10.8) to (39.8±10.13), Time Up And Go Test from (15.6±3.5) to (12.43±2.72), Fall Efficacy Test from (33.8±9.6) to (28.8±9.01), and Functional Reach Out Test from (21.03±6.2) to (23.7±7.13) for Group B.
Conclusion: The study concluded that Proprioceptive training was more effective than Vestibular rehabilitation therapy in reducing the risk of fall in elderly.

Key words: Risk of fall, Proprioceptive training, Vestibular training, Berg Balance Scale, Time Up and Go Test.

INTRODUCTION

Balance is defined as the ability to maintain an upright posture during static and dynamic tasks which requires complex interactions between peripheral and central factors such as vision, somatosensation, vestibular sensation, motor output, and musculature. [1] Balancing is an interplay and integration of contributions from vision, vestibular sense working in conjunction with the cerebellum, proprioception, muscle strength and reaction time. [2]

Postural control depends on the ability to extract peripheral sensory inputs, integrate this information within CNS, and coordinate and execute an appropriate motor response. Given that sensory inputs related to various environmental conditions are constantly changing, the ability to adjust instantly to a change in sensory information is central to the reduction of fall risk in older adults. [3]

A fall is a complex multifactorial phenomenon. In order to understand the falls, it is important to understand the prerequisites of normal gait. Essential components for a normal gait include fine neuronal networks such as the cortical–basal ganglia chain and the basal ganglia-

brainstem network, exquisite musculoskeletal structures with appropriately regulated muscle tone, and proper integration of sensory information from higher center starting from cerebral cortex, visual feedback, vestibular apparatus, fine touch, and proprioception. Effective coordination of those components, along with adequate cognition and concentration, is needed to prevent falls and maintain gait. [4]

Sensory information has an important influence on balance activity in older people and the integration of visual, vestibular, and somatosensory information is necessary to generate appropriate balance responses. [5]

Balance control also depends on healthy function across many brain areas. The brain needs to process and interpret sensory information, select appropriate balance strategies, and adapt and learn new strategies with practice. As we age, brain processing can slow down, which results in slower balance responses. People with cognitive problems also have balance problems, showing the importance of higher level brain processing in balance control. [6]

Normal aging affects all physiological processes. Subtle irreversible changes in the function of most organs can be shown to occur by the third and fourth decades of life, with progressive deterioration with age. [7]

With advancing age, degradations in the proprioception threshold or sensitivity result in failure to sense changes in the displacement of the body mass. Accordingly, older adults with diminished proprioception sensitivity may not be able to detect and correct postural disturbances as promptly as younger adults. [8] Falling has serious consequences for patients and caregivers. A fall prevention program should focus on reducing the consequences of falling and on promoting self-efficacy and activity. [9]

There is now strong evidence for the effectiveness of exercise in the prevention of falls in community-dwelling older people. Exercise is an obvious choice as a fall prevention intervention because impaired muscle strength and poor postural control are known to increase the risk of falling and are amendable to change with exercise. [10]

With increasing life expectancy, there is a need of better quality of life and health for elderly population. The major factor affecting the quality of life in elderly is frequent falls and the injuries associated with it, hence there is need for better intervention to prevent the risk of falls.

MATERIALS AND METHODS

Study type: Experimental study
Sample size: 60
Study Duration: 6 months
Study set up at: Senior citizen clubs across Pune city.
Target population: Elderly individuals visiting Senior citizen clubs
Participants: The Elderly individuals visiting Senior citizen clubs across city with age 65-75 years, male and female patients, those who are functionally independent and willing to participate were included in the study. Individuals who had undergone lower limb surgeries like Total Knee Replacement or Total Hip Replacement where the proprioception may be impaired, Patients diagnosed with Vestibular Basilar Insufficiency complaining of dizziness etc., and Patients who are using assistive devices were excluded from the study.
Procedure: Permission was taken from the institutional ethical committee of Tilak Maharashtra Vidyapeeth, Department of Physiotherapy. A survey was carried out on 100 elderly individuals across Senior citizen club to evaluate risk of fall in elderly individuals.
Prior to participation, patients were instructed and explained about treatment procedure and the benefits of intervention as well as effects of exercises. Consent form was filled by participants. Pre participation evaluation form included demographic details, the outcome measures like Berg Balance Scale (BBS), Time Up and Go Test

(TUG), Fall Efficacy Test (FET), Functional Reach out Test (FRT) to assess the balance and risk of fall. An assessor blind prospective trial was performed on these patients.

Patients were selected randomly allocated in Group A and Group B where Group A was given proprioceptive training and Group B was given vestibular rehabilitation therapy. Participants were evaluated pre-intervention using Berg Balance Scale, Time Up and Go Test, Fall Efficacy Test, and Functional Reach out Test on day 1 and at the end of 6 weeks post-intervention using Berg Balance Scale, Time Up and Go Test, Fall Efficacy Test, and Functional Reach out Test. Using these outcome measures participants were classified into mild, moderate and high risk of fall depending on the scores of outcome measures.

Proprioceptive Training:

The proprioceptive exercise program was conducted for 50 minutes including warm up and cool down each for 10mins and 30mins of proprioceptive exercises, 3 sessions per week for 6 weeks. Depending on patient's condition, exercises were chosen accordingly, and each exercise was given 10 times with 10 seconds hold. The proprioceptive exercises were progressed every week to challenge the balance according to patient's response. The exercises were progressed with eyes closed on static surface. The exercises included tandem standing, one leg standing, squats, backward walking, sideways walking, heel walking, toe walking, tandem walking, sideways kick, and backward kick.

Vestibular Training:

Patients in Group B were given vestibular rehabilitation therapy which includes adaptation and habituation exercises which is based on vestibular ocular reflex. Therapy was given for 3 days per week for 50 minutes every alternate day for 6 weeks. Each exercise was given 10 times with set of 3. The exercises which induced symptoms like dizziness were stopped and exercises were progressed according to patient's response. This exercises include :Eye and head movements first slowly then faster, Head and body movements in sitting which includes placing object on the floor, picking and bringing it above head and place it on the floor again, In standing, bending forward and taking an object through back and front of your knees, Circling shoulder, turning head to right and left along with it, Circling shoulder and bending head forward and backward along with it, Sitting down and standing up with eyes open and eyes closed Sit to stand, but turning to right and left while standing alternately, Throwing a small ball from 1 hand to other above eye level 10 times and then below knees alternatively.

Statistical analysis:

All statistical analysis was done using Instat software windows. Descriptive analysis was obtained by mean and standard deviation. The comparison between two groups was done using paired-'t' test whereas within group pre-intervention values were done using non-paired test.

RESULTS

Between group comparison showed significance improvement in Berg Balance Scale from (35.2± 12.03) to (42.7±11.03), Time Up And Go Test from (17.6±2.29) to (12.9±1.98), Fall Efficacy Test from (36.9±13.3) to (25.8±9), and Functional Reach Out Test from (20.12±4.7) to (23.0±4.73) for Group A as compared to Berg Balance Scale from (34.7±10.8) to (39.8±10.13), Time Up And Go Test from (15.6±3.5) to (12.43±2.72), Fall Efficacy Test from (33.8±9.6) to (28.8±9.01), and Functional Reach Out Test from (21.03±6.2) to (23.7±7.13) for Group B.

TABLE 1: BETWEEN GROUP COMPARISON PRE AND POST INTERVENTION

OUTCOME MEASURE		GROUP A (MEAN±SD) n=30	GROUP B (MEAN±SD) n=30	P-VALUE
Age		68.4±3.54	68.53±2.99	
Gender		Male = 8 , Female= 22	Male=15, Female=15	
TUG(sec)	PRE	17.6 ± 2.294	15.6 ± 3.529	
	POST	12.9± 1.98	14.9±2.72	
	DIFF	4.76±1.6	3.16±1.6	0.1
	P-VALUE	0.0001	0.01	
FES	PRE	36.97 ± 13.38	33.87 ± 9.68	
	POST	25.8± 9	28.8± 9.01	
	DIFF	11.6±7.3	5±4.59	0.1
	P-VALUE	0.02	0.03	
BBS	PRE	35.2 ± 12.03	34.7 ± 10.83	
	POST	42.7±11.03	39.8± 10.13	
	DIFF	7.533±2.886	5.16 ± 4.8	0.03
	P-VALUE	0.002	0.0001	
FRT(cm)	PRE	20.12±4.74	21.03 ±6.278	
	POST	23.0± 4.73	23.7± 7.13	
	DIFF	3.127±1.353	2.74 ± 2.43	0.004
	P-VALUE	0.1	0.1	

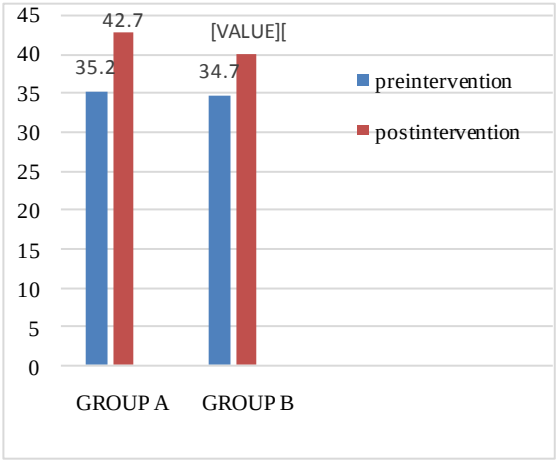

Figure 1: Between group comparison pre-postintervention for BBS

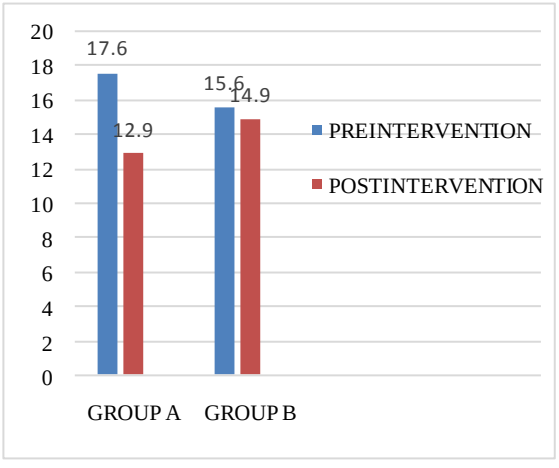

Figure 2: Between group comparison pre-post intervention for TUG

DISCUSSION

The aim of the study was to evaluate the effect of Proprioceptive Exercise Program Versus Vestibular Rehabilitation Therapy on risk of fall in elderly. Proprioceptive training given to Group A showed significant improvement in Time Up and Go test and Berg Balance Scale. Joint proprioception provides the neurological feedback needed for the control of muscle action, and serves as protection against excessive strain on passive joints. The proprioceptive training would have resulted in improved functional balance and in turn improvement in functional skills. An improvement in functional skills can decrease dependence on others. [11] Proprioception is mediated by receptors located within the skin, joints, and muscles. However, of these receptors, only muscle spindle demonstrate an ability to modulate sensitivity to muscle stretch, thereby representing the most promising avenue for training- related improvements to occur. [12] Thus training among seniors has a positive effect on the improvement of daily activities. Individual strength and balance training decreases risk of falls and improves self-confidence in everyday duties. [13]

One study, by Sergio Garcia, Andre Novo et al, [14] implemented the proprioceptive exercise program to evaluate the effect on functional capacity in elderly group. Out of 24 sample, 12 of them were included in intervention group and the other

12 subjects were included in control group. The total duration of program was of 12 weeks, 2 times per week consisting of 60mins session which includes 10 mins of warm up, 40mins of proprioceptive exercises and 10mins of cool down period. According to the result, the intervention group showed a statistically significant improvement in all evaluations performed after the program. In the control group, there was no significant improvement in functional capacity component evaluated after 12 weeks.

Group B showed significant improvement in Berg Balance Scale and Time Up and Go after vestibular rehabilitation therapy. Its proposed action is based on central mechanisms of neuroplasticity, known as adaptation, habituation and substitution, aiming a vestibular compensation. The aim of Vestibular Rehabilitation exercises is to improve the vestibule-visual interaction during cephalic movement and to increase static and dynamic postural stability in conditions that produce conflicting sensory information. [15]

One study, by John D. Macias et al [16] assessed the short term effectiveness of vestibular rehabilitation therapy in reducing fall risk in at-risk population. The 70 patients older than 50 years of age were treated at tertiary vestibular therapy center. The result demonstrated statistically significant improvement in berg balance score post-intervention. In conclusion, vestibular rehabilitation therapy significantly reduces the risk of fall in elderly at-risk patients with improvement measured at the termination of therapy.

Overall, between group comparisons post intervention showed balance improvement in both the groups however, proprioceptive exercise program improved balance significantly relative to vestibular rehabilitation therapy.

Another study, by Isabella KatharniaWiesmeier et.al [17] analysed postural control of 20 health elderly people with a mean age of 74 years. The findings were compared to data from 19 healthy young volunteers with mean age of 28 years and 16 healthy middle aged volunteers with mean age of 48 years. The study found that spontaneous sway amplitude and velocity were significantly larger, and sway frequencies were higher in elderly compared to young people. Also, elderly favor proprioceptive over visual and vestibular cues, other than younger subjects do.

Thus, this study illustrates that both intervention helped in improving balance but proprioceptive training was more effective than vestibular rehabilitation therapy to prevent the fall in elderly population.

CONCLUSION

Both Proprioceptive Training and Vestibular Rehabilitation Therapy were effective in improving the balance hence reducing the risk of fall in elderly population. Proprioceptive Training was more effective as compared to Vestibular Rehabilitation Therapy.

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