EFFECT OF VESTIBULAR EXERCISE ON BALANCE AMONG ACROPHOBIA

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ABSTRACT

BACKGROUND: Acrophobia is a one of the anxiety disorder in which the persons have the fear of height. The visual stimulus provokes acrophobia symptoms like dizziness, palpitation, postural instability.

OBJECTIVE: The study aims to find the effect of vestibular training on balance among acrophobia.

METHODOLOGY: Experimental, pre and post-test, convenient sampling, sample size was 30 subjects. Subjects of 17 to 22 years, who are having moderate acrophobia and who fulfill the Diagnostic and Statistical Manual of mental disorder V criteria were included in the study. The exclusion criteria were any neurological disorders, antidepressant drug, recent musculoskeletal injury, patient underwent hypotonic therapy and cognitive therapy. Group A (15 subjects) were trained with vestibular exercises and Group B(15 subjects)were not been treated .

OUTCOMEMEASURE: Visual Height Intolerance Questionnaire, Vestibular Rehabilitation Benefit Questionnaire and Sharpened Romberg test.

RESULTS: pre-test and post-test values of Visual Height Intolerance are 6.1333 and 4.6667, pre-test and post-test values of Vestibular Rehabilitation Benefit Questionnaire is 0.740 and 0.0502 and pre-test and post-test values of Sharpened Romberg Test is 29.4000 and 39.3333. so, there was a significant improvement in balance ($p < 0.05$).

CONCLUSION: After the completion of 4 weeks of vestibular training the acrophobic subjects show significant improvement performance and balance was found to be improved.

KEYWORDS*:* Acrophobia, vestibular, Visual Height Intolerance Questionnaire, Vestibular Rehabilitation Benefit Questionnaire and Sharpened Romberg test.

I.INTRODUCTION

Acrophobia is an anxiety disorder in which the persons have the fear of height. The term "*ACROPHOBIA*" is from Greek "*AKRON*", which means "peak, summit, edge" and phobia means "fear". A prevalence rate of occurring acrophobia is 1 in 20 adults [1].It is more common in female than male.Dinardo et al (1998) concluded that a commonly held view is that a fear of heights in learned response from traumatic experience and event[2]. Menzies and Clarke 1993 suggest that fear of height may be "Inborn"[3]. In persons with acrophobia, some suffer being afraid to go upstairs, ladder or to stand on a chair, table[4].The acrophobia is one of the anxieties which are due to biopsychosocial factors[5]. The postural control for the acrophobic patient is more reliant with optic flow[6]. Optical flow is a comparative motion between a person and the reality of the pattern of movement of edges, surfaces, and objects in a visual scene[7].There are two main factors which determine the person to get acrophobia. They are physiological and psychological which interact with each other. Physiological factors which affect the person in the height places such as body reaction e.g. palpitation, anxiety. Psychological factors again classified into internal factors and external factors. The internal factor which induces individual mental status like fear of fall will vary from individual to individual and external factors such as critical situation will also induce the fear[5].

The visual stimulus induces the acrophobia that provokes the height vertigo[8]. If the acrophobic persons are introduced to a height situation which leads to the emotional reactions such as dizziness, nausea, vomiting, postural instability, shortness of breath, palpitation, sweating, feeling faint, trembling and shaking[9]. There are some common etiological factors which provoke acrophobia such as balance impairment, vestibular dysfunction[8]. A postural control involves the maintenance of alignment of body posture and a vertical relationship against gravity forces[10-11]. There is a small amount of sway occurs in a quiet stance which helps to maintain the body in equilibrium, these kinds of forward and backward sway during standing helps to give a feedback to the nervous system about the orientation of postural segments which helps the body to maintain equilibrium[12].

The cerebral hemisphere especially the sensory context (postcentral gyrus) plays a major role in vestibular sensation. The sensory cortex carries various kind of vestibular information and processed to the sense of spatial orientation and motion perceptions. A connection between the vestibular systems to the cerebral hemisphere is wide spread[13]. The vestibular nuclei project excitatory vestibular neurons to the lateral and inferior ventro-posterior lateral thalamic nucleus (VPL) to report head motion activities in darkness, whereas descending projections neurons that are mostly inhibitory project from the cerebral cortex to the vestibular cerebellum[14-16]. The cerebral cortex, particularly the peri-insulor vestibular cortex (PIVC), receives information not only from the

vestibular system but also visual and somatosensory stimuli, and vestibular neurons in the peri-insulor vestibular cortex are activated not only by vestibular stimuli but also somatosensory and visual stimuli; sensory information conflict may cause feelings of nausea, motion discomfort, motion sickness, and fear of height[17-20].The central nervous system plays a major role in controlling the orientation of posture and stability in various environmental demands. These kinds of postural adaptations are controlled by cerebellum and muscles response and its magnitude depending upon the task requirements[21].

Brainstem nuclei role in postural control include: 1. Regulation of muscles facilitation /inhibitionand muscle/postural tone adjustment for postural control 2. Regulation of sensory information important for anticipatory movement strategy for balance control. Spinal cord neural circuitry controls postural tone and activates antigravity muscle [22-23].Thecentral nervous system controls balance by receiving the sensory inputs via the visual, somatosensory and vestibular system. These systems integrated together and process in the central nervous system to control postural stability[24]. If there is information reduction from any of these channels it will lead to an increase in postural sway, dizziness and height vertigo which can occur in a healthy individual in the challenging situation like standing on height, walking in a crowd, supermarkets[25]. The major function of the peripheral vestibular system is stabilizing visual images for clear vision during movement of the head, maintaining posture and stability during head movement and helps in spatial orientation[26].

Due to the vestibular impairment, the person may have the secondary complications like poor balance control, dizziness during the stuff situations like during traveling, standing on height places[25]. Evidence suggests that an individualized approach to the vestibular rehabilitation is important for a better outcome which reduces the acrophobia[27].The vestibular training for acrophobic persons will reduce the visual intolerance by correcting the postural instability which is commonly induced to them [8]. Vestibular rehabilitation helps it improve the balance by correcting the visual-vestibular impairment which commonly induces the acrophobia[28].The distance exceeds between a person and the nearest stationary visible objects which leads to height vertigo [29]. The increase in visual distance is high place which may cause a lack of visual information which is commonly used to maintain balance [25].

There is a change in behavior to increase visual balance feedback when an acrophobic persongoto height places and increase in sway response [30]. The body sway is similar to a sway during eye closure [31].when sway increases the center of gravity moves outwards and approaches the boundary of support with increases instability [32].Evidence suggests that vestibular physical therapy may be useful for the patients with agoraphobia [33]. Rahko et al found that most of the patients with benign positional vertigo associated with acrophobia, reported a reduction in their symptoms after the vestibular rehabilitation programme[34,35,36].

II.AIM OF THE STUDY

To find the effect of the vestibular training on balance among subjects with acrophobia.

III.NEED FOR THE STUDY

There is less number of study done through the physiological factors which directly induces acrophobia such as vestibular system, musculoskeletal system and proprioception. Due to balance impairment the acrophobic persons will usually tend to avoid themselvesexposing to/experience severe anxiety or dread of being great height which in turn significantly impacts their quality of life. So, this study has been designed to analyze the effect of vestibular training on balance among acrophobic subjects.

IV.METHODOLOGY

STUDY DESIGN: Experimental

STUDY TYPE: Pre and Post type

SAMPLING METHOD:Convenient sampling

SAMPLE SIZE : 30

STUDY DURATION: 4 weeks

STUDYSETTING: SRM College of Physiotherapy, SRM Institute of science and Technology, Kattankulathur campus.

INCLUSION CRITERIA:

Age 18- 25 years.

Moderate acrophobia [visual height intolerance scale (6 to 9)]

Both the gender.

The persons who fulfill the Diagnostic and statistical manual of mental disorder[DSM] v criteria.

EXCLUSION CRITERIA:

Neurological disorder which induces severe dizziness and anxiety-like epilepsy.

Musculoskeletal injury like lower limb fractures, ligament sprains, foot disorder.

Respiratory problems like bronchial asthma.

Patient under antidepressant medication.

History of drug abuse.

Previous history of hypnotherapy, cognitive behavior therapy.

Past history of emotional trauma related to height.

MATERIALS USED

1. Soft Foam

2. Wobble board

PROCEDURE

According to the inclusion and exclusion criteria, 30 subjects were approached and informed consent was taken to the subjects before the study done. The subjects were selected based on the DSM V (Diagnostic and Statistical Manual of Mental Disorder). The Pretest was done by asking the subjects to view from the balcony [60 feet]. The severities of the acrophobia were measured by using the subjective scale that is Visual Height Intolerance Questionnaire. The subject was included to the study only if they having the moderate score (6-9) in the Visual Height Intolerance Scale. The pretest of vestibular impairment was assessed through the Vestibular Benefit Rehabilitation Questionnaire. The pretest for the balance impairment was assessed using the sharpened Romberg test.

Sharpened Romberg test: The subject was asked to do tandem position, in which one foot is placed just in front of other foot and placed the arm across the shoulder then eyes are closed ask to keep this position as far as possible. The subjects were divided into group A and group B, each group consists of 15 subjects. The Group A subjects were trained under the vestibular exercises. The Group B subjects are the control group and no training was given to them. The Vestibular training was given to the Group A for 4 weeks [3 days a week], each session consists of 45 minutes.

VESTIBULAR TRAINING

Week 1

Subjects were asked to place feet together in standing on a pillow. They were made to walk with pitch plane head movements. The subjects were made to Stand on the cushion: eye closed and to march in place, standing weight shift. Subjects were asked to stand on a balance board and were asked to focus in the medial to lateral and then anterior to posterior direction simultaneously they were asked to catch a ball. In the standing position VOR×1 cancellation with the card moving up and down was done.

Week 2

The subjects were asked to walk backward with pitch and yaw[right/left] head movement along with counting. Subjects are asked to stand in semi-tandem position with eyes open on a pillow and in single leg stance. They were encouraged to practice standing on one leg on foam.

Subjects are asked to walk with head in the pitch plane(upward and downward movement of head).Subjects were asked to stand on a balance board and were asked to focus in the medial to lateral and then anterior to posterior direction simultaneously they were asked to catch a ball. In the standing position VOR×1 cancellation with the card moving up and down was done.

Week 3

Subjects are asked to stand and march on an unstable surface like foam. Subjects are asked to do Standing, marching on foam, tossing balls, and counting. Tossing balls while standing on a balance board. Walking down the hallway with eye closed.VOR×1 cancellation in single-leg stance.Standing on foam, feet apart, eyes closed while moving the head in the pitch(up/down) and yaw (right and left) planes.

Week 4:

Subjects were asked walk with ball toss along with the up and down head movement. Subjects are asked to climb up stairs while stepping up and down from a 20.3 cm step.Subjects are asked to climb up stair while stepping upthey are asked to move towards

the left and when moving down to the right.Subjects are asked to toss a ball and while tossing they are made to say the alphabetsfrom the end (z to a)Subjects are asked to ball toss on an unstable surface like a foam pad. Subjects were asked to catch a ball while rocking on a wobble board.Subjects were asked to rock on a wobble board by placing one foot in front of other foot (tandem Romberg position).

OUTCOME MEASURES

Visual Height Intolerance Scale.

Vestibular Rehabilitation Benefit Questionnaire.

Sharpened Romberg Test

V.DATA ANALYSIS

The collected data were tabulated and analyzed using IBM SPSS VERSION 20 SOFTWARE. For the descriptive statistics, the mean and standard deviation were calculated and for the inferential statistics, the parametric variables were treated with a t-test. The results were tabulated and the results were plotted accordingly.

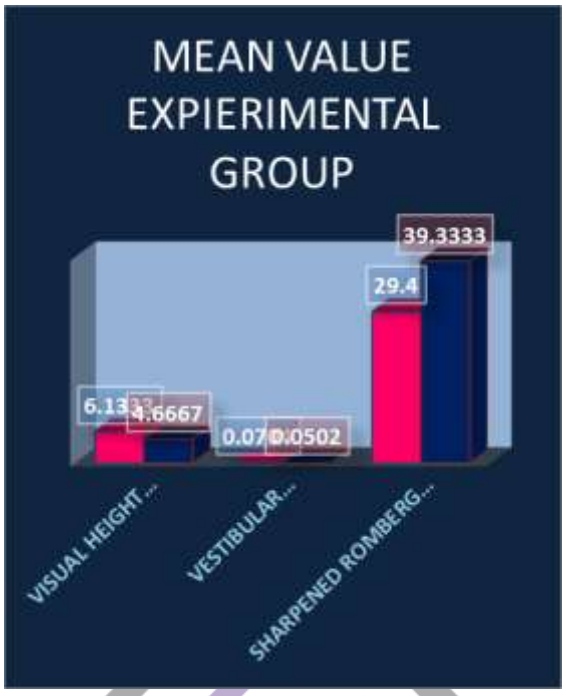
Variables	Mean	N	Std. Deviation	Std. Error Mean	T	Df	Sig(2-tailed)
PRE-TEST VHI EXP POST TEST VHI EXP	6.1333 4.6667	15 15	1.0601 .72375	.27372 .18687	5.047	14	.000
PRE TEST VBQ EXP POST TEST VBQ EXP	.0704 .0502	15 15	.05441 .03957	.01405 .01022	3.876	14	.002
PRE TEST SRT EXP POST TEST SRT EXP	29.4 39.3333	15 15	9.41731 9.6929	2.43154 2.5027	-20.170	14	.000

TABLE 1

PRE-TEST AND POST-TEST MEAN VALUE OF FEAR OF HEIGHT AS MEASURED BY VISUAL HEIGHT INTOLERANCE QUESTIONNAIRE, SEVERITY OF VESTIBULAR IMPAIRMENT IS MEASURED BY VESTIBULAR REHABILITATION BENEFIT QUESTIONNAIRE AND BALANCE IS MEASURED BY SHARPENED ROMBERG TEST AMONG GROUP A ACROPHOBIC SUBJECTS TREATED WITH VESTIBULAR EXERCISE FOR 4 WEEKS.

P value<0.05

According to the table 1, the pre-test mean value of Visual Height Intolerance is 6.1333 and the post-test mean value is 4.6667 so, there is a significant reduction in fear of height in Group A with p value of 0.00 ,the pre-test mean value of Vestibular Rehabilitation Benefit Questionnaire is 0.0704 and the post-test value is 0.0502 hence there is significant improvement in vestibular symptoms with p value is 0.02, and the pre-test mean value of sharpened Romberg test is 29.4000 and the post-test value is 39.3333 which shows that there is a significant improvement in balance with p value is 0.00.



GRAPH-1

PRE-TEST AND POST-TEST MEAN VALUE OF FEAR OF HEIGHT AS MEASURED BY VISUAL HEIGHT INTOLERANCE QUESTIONNAIRE, SEVERITY OF VESTIBULAR IMPAIRMENT IS MEASURED BY VESTIBULAR REHABILITATION BENEFIT QUESTIONNAIRE AND BALANCE IS MEASURED BY SHARPENED ROMBERG TEST AMONG GROUP A ACROPHOBIC SUBJECTS TREATED WITH VESTIBULAR EXERCISE FOR 4 WEEKS.

Variablese	Mean	N	Std. Deviation	Std. Error Mean	T	Df	Sig(2-tailed)
PRE TEST VHI CON POST TEST VHI CON	5.6667 5.6667	15 15	.72375 .72375	.18687 .18687	---	---	---
PRE TEST VBQ CON POST TEST VBQ CON	.0588 .0583	15 15	.03627 .03664	.00937 .00946	1.000	14	.33
PRE TEST SRT TEST POST TEST SRT CON	34.7333 34.6667	15 15	6.04113 5.76525	1.55981 1.48858	0.113	14	.91

TABLE-2

PRE-TEST AND POST-TEST MEAN VALUE OF FEAR OF HEIGHT AS MEASURED BY VISUAL HEIGHT INTOLERANCE QUESTIONNAIRE, SEVERITY OF VESTIBULAR IMPAIRMENT IS MEASURED BY VESTIBULAR REHABILITATION BENEFIT QUESTIONNAIRE AND BALANCE IS MEASURED BY SHARPENED ROMBERG TEST AMONG GROUP B ACROPHOBIC SUBJECTS TREATED WITH NO TREATMENT.

P value<0.05

According to the table 2,the pre-test mean value of Visual Height Intolerance is 5.6667 and the post-test mean value is 5.6667 so, there is a no significant reduction in fear of height in group B, the pre-test mean value of Vestibular Rehabilitation Benefit Questionnaire is 0.0588 and the post-test value is 0.0583 hence there is no significant improvement in vestibular symptoms with p value is 0.334, and the pre-test mean value of sharpened Romberg test is 34.7333 and the post-test value is 34.6667 which shows that there is a no significant improvement in balance with p value is 0.912.

GRAPH-2

PRE-TEST AND POST-TEST MEAN VALUE OF FEAR OF HEIGHT AS MEASURED BY VISUAL HEIGHT INTOLERANCE QUESTIONNAIRE, SEVERITY OF VESTIBULAR IMPAIRMENT IS MEASURED BY VESTIBULAR REHABILITATION BENEFIT QUESTIONNAIRE AND BALANCE IS MEASURED BY SHARPENED ROMBERG TEST AMONG GROUP B ACROPHOBIC SUBJECTS TREATED WITH NO TREATMENT.

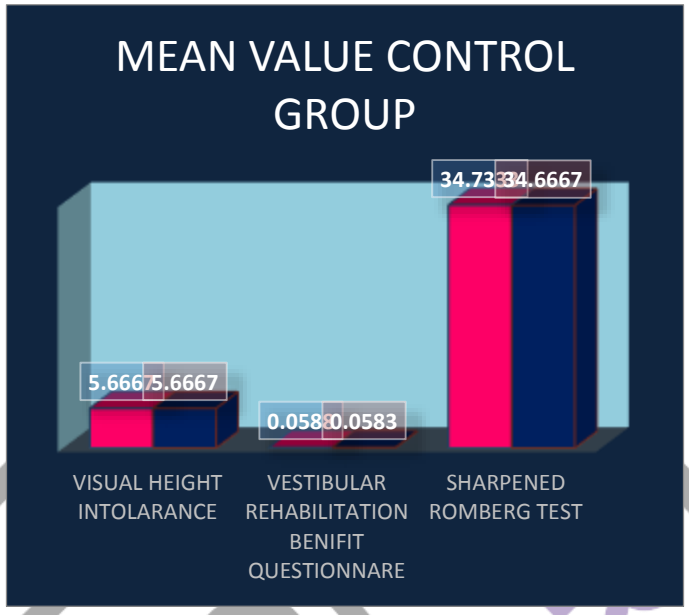


TABLE-3

COMPARISON OF POST-TEST MEAN VALUE OF FEAR OF HEIGHT AS MEASURED BY VISUAL HEIGHT INTOLERANCE QUESTIONNAIRE, SEVERITY OF VESTIBULAR IMPAIRMENT IS MEASURED BY VESTIBULAR REHABILITATION BENEFIT QUESTIONNAIRE AND BALANCE IS MEASURED BY SHARPENED ROMBERG TEST BETWEEN GROUP A AND GROUP B ACROPHOBIC SUBJECTS.

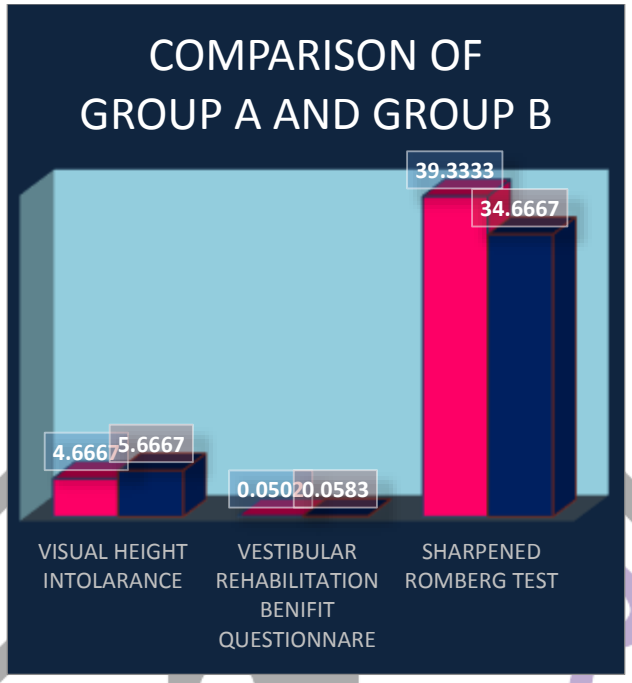
			Levene's Test for Equality of Variances		t test for equality of means	
COMPARSION OF GROUP A & GROUP B		Mean Value	F	Sig	T	Sig (2-tailed)
POST TEST VHI	EXP	4.6667	.000	1.000	-3.784	.001
	CON	5.6667			-3.784	.001
POST TEST VBQ	EXP	.0502	.116	.736	-.582	.565
	CON	.0583			-.582	.565
POST TEST SRT	EXP	39.3333	5.807	.023	1.603	.120
	CON	34.6667		.023	1.603	.120

P value<0.05

According to the table 3, There was a significant difference between Group A and Group B of Visual height intolerance questionnaire with P<0.005. There was no significant difference between Group A and Group B of vestibular rehabilitation benefit questionnaire and sharpened Romberg test with p value>0.005.

GRAPH-3

COMPARISON OF POST TEST VALUES OF VISUAL HEIGHT INTOLERANCE QUESTIONNAIRE, VESTIBULAR REHABILITATION BENEFIT QUESTIONNAIRE, SHARPENED ROMBERG TEST AMONG GROUP A (EXPERIMENTAL GROUP) ACROPHOBIC SUBJECTS TREATED WITH VESTIBULAR EXERCISE FOR 4 WEEKS AND GROUP B (CONTROL GROUP) ACROPHOBIC SUBJECTS WITHOUT TREATMENT.



VI.RESULTS

A total of 30 subjects were taken in this study. Experimental group consists of 15 members and another 15 members are the control group.

Table 1 shows that the mean values of the experimental group. There was a significant improvement in balance, visual height intolerance and vestibular symptoms and the P value was P<0.02 and that of t value of Visual Height Intolerance is 5.047, Vestibular rehabilitation benefit questionnaire is 3.876 and Sharpened Romberg test is 20.170.

Graph 1 shows that the mean values of pre and post-test of the experimental group that treated with vestibular exercise for 4 weeks. The initial value of Visual Height Intolerance is 6.1333, Vestibular Rehabilitation Benefit Questionnaire is 0.740 and Sharpened Romberg Test is 29.4000. the post-test mean values of Visual Height Intolerance is 4.6667, Vestibular Rehabilitation Benefit Questionnaire is 0.0502 and Sharpened Romberg Test is 39.3333.

Table2and Graph 2 shows that mean values of the control group. There was no significant improvement in balance, visual height intolerance, and vestibular symptoms. The mean values of pre and post-test of a control group that treated with no treatment. The initial values of Visual Height Intolerance are 5.6667, Vestibular Rehabilitation Benefit Questionnaire is 0.0588 and Sharpened Romberg Test is 34.7333. the post-test mean values of Visual Height Intolerance is 5.6667, Vestibular Rehabilitation Benefit Questionnaire is 0.0583 and Sharpened Romberg Test is 34.6667.

Table 3 and Graph 3 shows that there was a significant difference between Group A and Group B of Visual height intolerance questionnaire with P<0.005. There was no significant difference between Group A and Group B of vestibular rehabilitation benefit questionnaire and sharpened Romberg test with p value>0.005.

VII.DISCUSSION

The aim of this study is directed to find the effect of vestibular rehabilitation on balance performance among acrophobic person.

The severities of the acrophobia were measured by using the subjective scale that is Visual Height Intolerance Questionnaire**,** Severity of Vestibular Impairment is measured by Vestibular Rehabilitation Benefit Questionnaire and Balance is measured by Sharpened Romberg Test.

The subjects were divided into group A and group B, each group consists of 15 subjects. The Group A subjects were trained under the vestibular exercises. The Group B subjects are the control group and no training was given to them.

The vestibular dysfunction is one of the main causes which provokes acrophobia. The vestibular system is a major system which contributes to postural stability among normal individual. The vestibular impairment also affects the balance performance and quality of life among acrophobia.

By correcting the vestibular impairment, the person will efficiently recognize the linear, angular and also rotational orientation of the head. The vestibular rehabilitation programme training consists of a dynamic base of support that will improve the proprioception, muscle coordination, and to maintain the posture. During the course of the study, the subjects did the exercise in a perfect manner. This was due to the learned coordinated movements by the muscle which maintaining the postural control. Hence this revealed that vestibular training will improve balance performance efficiently.

Yardley et al., (1998) revealed that the balance impairment is improved by habituation and relearning a variety of challenging situation which requires more coordinated muscle work along with the vestibular training activities. The vestibular rehabilitation program helps the people with vestibular damage and it is not only by improving their physical performance. It also has an effect on the psychological issues such as anxiety, arousal, attention, and motivation.

However, the psychological issues were reduced in this study. The rehabilitation training mainly concentrated on physical therapy which focuses on balance and vestibular correction. Therefore, the results show a specifically significant improvement in balance impairment with the persons acrophobia. But the fear during the height places was not efficiently reduced during the post-test of the visual height intolerance questionnaire which denotes the persons needs also the behavior therapy and habituation exercises on the height places to adapt with the height places and reduce the fear of heights.

Rolf G Jacob et al., (2005) suggested that vestibular physical therapy is an effective treatment along with virtual reality and behaviour therapy. The virtual reality therapy and behaviour therapy did not reduce the symptoms like dizziness and imbalance. However, persons with acrophobia, vestibular physical therapy is essential, along with other therapy[8].

Redfern MS et al., (2001) said that the vestibular rehabilitation teaches an individual to find the causes and reduce dizziness, also to cope with provoking factors through systemically and psychologically. Thus, vestibular rehabilitation is considered as a form of behavioural intervention [38].

In this study, 15 subjects with acrophobia were trained with vestibular exercise who showed a significant reduction in Vestibular symptoms ($p<0.02$) and improved balance significantly ($p<0.00$). The results show that there was a significant benefit following vestibular exercise which is an effective treatment for improving balance among acrophobia.

This study also revealed that there is a decrease in fear of height, vestibular symptoms and also improved quality of life.

When compared with the Group B, the Group A subjects show an improvement in visual height intolerance which can be due to the improvement in the physical factors which contribute to fear of falling in height places such as vestibular dysfunction and poor balance.

The post-test when assessed shows a significant improvement in balance performance and a decrease in the level of dizziness. Although there was an improvement in physical performance across all subjects and the psychological factors which influence the fear of falling showing no marked level of improvement[8].

This study shows that there is an improvement in visual height intolerance, vestibular symptoms and balance among acrophobic subjects.

VIII.CONCLUSION

The study concluded that in Group A the balance in subjects with acrophobia was improved,it also revealed that there was a significant reduction in the fear of height,the vestibular symptoms and also it improves quality of life which indicates that vestibular exercise will improve balance among acrophobia subjects. Hence to improve balance among acrophobic subjects the vestibular exercisesis an effective treatment.

LIMITATIONS AND RECOMMENDATIONS

IX.LIMITATIONS:

The duration of study is less.

Gender Distribution is not equal.

X.RECOMMENDATIONS:

We also recommend the future study to be conducted by exposing the subjects with real environmental exposure to find out the effect of vestibular exercises.

Long term follow up can be done.

Further studies can be done including subjects of different age groups.

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