Original Article

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Role of Vestibular Adaptation Exercises on Motion Sickness

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Abstract

Objective: The study was done to find the effects of the vestibular adaption exercises on the motion sickness. *Methods:* The study was done on 25 subjects with the signs and symptoms of motion sickness while travelling in a bus, car or train, selected according to the inclusion and exclusion criteria and carried out in the O.P.D. of physiotherapy at CSS Hospital, Meerut. The score were measured before the application of the vestibular adaptation exercises and just after completion of vestibular adaption exercises for Total Duration of 40 min per session, Twice a day (40 + 40 min= 80 min every day) per week, for 12 weeks. The mean standard deviation (S.D) and standard error (S.E) are being calculated to perform the entire statistical data. The "t" test was used for analysis and the significant difference was calculated from the statistical data. *Results:* The 't' test result shows that the difference between 0-4 week is less significant as the 't' value is 2.20, and the difference between 4-8 week is significant as the 't' value is 2.46, while the difference between week 4-8 & week 8-12 is significant as the 't' value is 2.47. After comparing the pre-experimental and post- experimental data I saw that the vestibular adaption exercises have the very significant value on motion sickness. Therefore, vestibular adaption exercises can be safely used to decrease the motion sickness.

Keywords: Vestibular Adaption Exercise; Motion Sickness; Vestibular Rehabilitation Therapy.

Introduction

Motion sickness is also known as travel sickness, is a condition in which a disagreement exists between visually perceived movement and the vestibular system's sense of movement. Depending on the cause it can also be referred to as car sickness, bus sickness or train sickness [1]. Dizziness, fatigue, and nausea are the most common symptoms of motion sickness [2]. If the motion causing nausea is not resolved, the sufferer will frequently vomit. Unlike ordinary sickness, vomiting in motion sickness tends not to relieve the nausea. About 33% of people are susceptible to motion sickness even in mild circumstances such as being on a boat in calm water, although nearly 66% of people are susceptible in more conditions [3]. Individuals and animals without a functional vestibular system are immune to motion sickness [4].

The restrictive definition (e.g., onset of vomiting, nausea) and lack of clear diagnostic testing may result in false negative identification and an underestimation of the incidence of motion sickness [5]. If current theories of motion sickness are correct then the principles of habituation that have been applied with varying success to reduce or prevent motion sickness in pilots and astronauts [6] might be applicable to the development of evaluation and treatment methods for individuals with motion sickness that interferes with daily function.

Motion is sensed by the brain through three different pathways of the nervous system that send signals coming from the inner ear (sensing motion, acceleration, and gravity), the eyes (vision), and the deeper tissues of the body surface (proprioceptors). When the body is moved intentionally, for example, when we walk, the input from all three pathways is coordinated by our brain. When there is unintentional movement of the body, as occurs during motion when driving in a car, the brain is not coordinating the input, and there is thought to be in-coordination or conflict among the inputs from the

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three pathways. It is hypothesized that the conflict among the inputs is responsible for motion sickness. Many of the drugs that are used to treat motion sickness act by influencing or affecting the levels of these compounds within the brain. Without the motion-sensing organs of the inner ear, motion sickness does not occur, suggesting that the inner ear is critical for the development of motion sickness. Visual input seems to be of lesser importance, since blind people can develop motion sickness. Motion sickness is more likely to occur with complex types of movement, especially movement that is slow or involves two different directions (for example, vertical and horizontal) at the same time.

Sudden jerky movements tend to be worse for provoking motion sickness than slower smooth ones, because they disrupt the fluid balance more. Motion sickness is greatest for vertical sinusoidal motion in the frequency range of 0.05- 0.08 Hz and is maximal at 0.167 Hz [7]. The most common hypothesis for the cause of motion sickness is that it functions as a defense mechanism against neurotoxins [8].

Vestibular Rehablitaton Therapy

Vestibular Rehabilitation Therapy (VRT) is a form of physical therapy that uses specialized exercises that result in gaze and gait stabilization. Most VRT exercises involve head movement, and head movements are essential in stimulating and retraining the vestibular system. Vestibular rehabilitation therapy has been a highly effective modality for most adults and children with disorder of the vestibular or central balance system. The basis for the success of VRT is the use of existing neural mechanisms in the human brain for adaptation, plasticity and compensation. The extent of vestibular compensation and adaptation is closely related to the direction, duration, frequency, magnitude and nature of the retraining stimulus. Our inner ear controls our sense of balance. The delicate bones and organs of the inner ear are known as the vestibular system. If something goes wrong with this system due to illness or injury, we may find our self dizzy, nauseous and unable to balance properly. Vestibular adaptation exercises strive to train our body to compensate and regain our sense of balance. A trained therapist will work to learn exercises to compensate for particular condition [9].

Vestibular System

The vestibular system is the system of balance. It is also involved in the function of maintaining visual fixation during head movement and in maintaining posture and lower muscular control. An understanding of the anatomy and physiology of the normal vestibular system is the first step in being able to understand the symptoms, physical exam findings, and testing results during disease states.

The vestibular system is made of five sensory organs on each side of the head embedded in the petrous portion of the temporal bone. There are the superior, posterior, and lateral semicircular canals as wells as the utricle and saccule [10].

Statement of Study

Does the vestibular adaptation exercises effects on motion sickness?

Aims and Objectives

To investigate the effect of vestibular adaptation exercises on motion sickness.

Materials and Methods

- Questionnaire
- Stationary
- Inches tape
- Stop watch
- Target
- Chair/Stool
- Statistical tests

Vestibular Adaptation Exercises

There are numerous exercises but the most popular exercises are:

1. Head fixed, object fixed & eye balls moving.
2. Head fixed, object & eye balls moving.
3. Head moving, object fixed && eye balls moving.
4. Head, object & eye balls moving.

Hypothesis

Experimental Hypothesis

The Vestibular adaptation exercises decreases the motion sickness.

Null Hypothesis

The Vestibular adaptation exercises does not effect on motion sickness.

Significance

1. This research should be able to give concrete baseline information regarding the effects of vestibular adaptation exercises on motion sickness and its modification for therapeutic intervention.
2. The result of this study would be widely applied in clinics as well as in hospitals.
3. This research would upgrade the professional skills and show the path for future research.

Limitation of Study

1. Small sample size.
2. Short duration.

Sample

Convenient sample of 25 subjects with the signs and symptoms of motion sickness while travelling in a bus, car or train, according to the inclusion and exclusion criteria, were include in the study. The study was conducted in the O.P.D. of Physiotherapy at CSS Hospital and Jai Physiotherapy and Dental Clinic, SF-06, Ansal Galleria, Ansal Town, Meerut.

Variables

Dependent variable: Motion sickness.

Independent variable: Vestibular adaptation exercises.

Inclusion Criteria

- Age between 17 – 25 years.
- Presence of signs and symptoms of motion sickness.
- Normal subjects without any pathology.

Exclusion Criteria

- Individuals on medications for motion sickness.
- Individuals with any kind of central or peripheral vestibular pathologies.
- Subjects who are suffering from any kind of injury, fracture or any other pathology.

Protocol

After getting their informed consent, the protocol of the vestibular adaption exercises was told to them.

Vestibular Adaptation Exercises

1. Rising while focused

   INTENSITY: 5 repetitions / 30 seconds.

   Total= 20 repetitions.

   2 minutes break after every 5 repetitions.

   DURATION: 10 min
2. Moving head while focused

   INTENSITY: 5 repetitions / 30 seconds.

   Total= 20 repetitions.

   2 minutes break after every 5 repetitions.

   DURATION: 10 min.
3. Focus on moving target

   INTENSITY: 5 repetitions / 30 seconds.

   Total= 20 repetitions.

   2 minutes break after every 5 repetitions.

   DURATION: 10 min.
4. Move with moving target

   INTENSITY: 5 repetitions / 30 seconds.

   Total= 20 repetitions.

   2 minutes break after every 5 repetitions.

   DURATION: 10 min.

Total Duration

40 min per session, twice a day (40 + 40 min), = 80 min every day, per week for 12 weeks.

Time of Scoring

All the scoring of data was recorded prior to the commencement of the treatment and after every week till 12 weeks by using a motion sickness severity questionnaire.

Procedure

Rising While Focused

Sitting in a chair, focus on a stable object across the room, 5 to 10 feet away. Keeping your focus on this object, stand up. Repeat this exercise as prescribed and remain balanced. Then practice sitting and standing with your eyes closed.

Moving Head While Focused

Focus your gaze on a bright object about 5-feet away. This could be a picture on the wall or a target

printed on a piece of paper and tacked to the wall. Keep your eyes focused on this object while you turn your head from side to side, slowly at first, then more rapidly.

Focus on Moving Target

This time, you remain still but follow the movement of a target with your eyes. The direction of the target's movement will vary, from side to side to up and down and diagonal.

Move with Moving Target

While focused on a target, you'll be asked to move your head in the opposite direction of the target, while keeping your eyes locked to the target. You may also be asked to move in the same direction as the target [11].

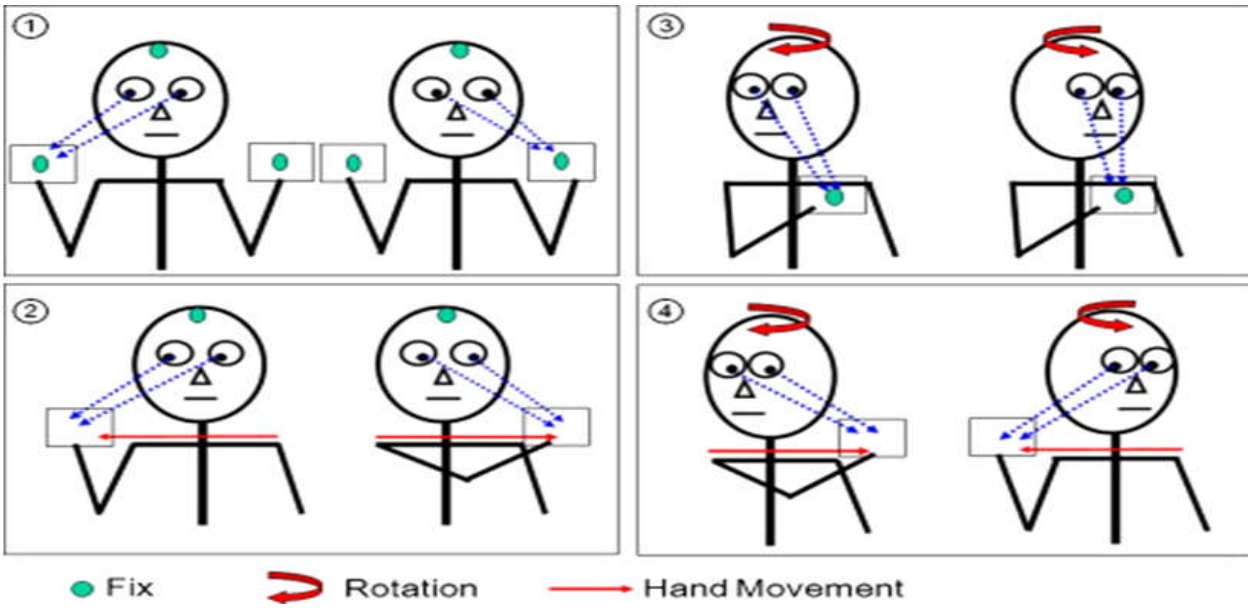


Fig. 1: Diagram of vestibular adaptation exercises

Data Analysis

The effect of vestibular adaptation exercises was recorded on motion sickness susceptibility questionnaire on 1st ,2nd , 3rd ,4th , 5th , 6th ,7th , 8th, 9th , 10th , 11th and 12th week and were compared with the readings which was taken prior to the treatment.

The mean standard deviation (S.D) and standard error (S.E) are being calculated to perform the entire statistical data. The "t" test was used for analysis and the significant difference was calculated from the statistical data.

Formula

1. Mean – It is denoted by and is given by $\bar{X}$

$\bar{X}$= Sum of all the observations / Total no. of observations

$$\sum_{i=1}^{n} xi = \bar{x}$$

2. Standard Deviation(S.D) – It is denoted by (sigma) and is given by

$$\delta = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(xi \quad \bar{x})}$$

3. Standard Error of Mean (S.E.M)

$$S.E.M = \delta/\sqrt{n}$$

4. Paired't' test: It is used to test the significant difference between pre and post observational study for the same sample.

$$t = \bar{d}/S.D/\sqrt{n}$$

$H_{0=}$ (Null Hypothesis)

No significant difference is observed between pre and post observation.

$$t = \bar{d}/S.D/\sqrt{n} \quad \sim t_{(n-1)} d.f., \propto$$

Where $\bar{d}$= mean difference between pre and post observations.

S.D = Standard Deviation of difference

n = Sample size

If – $t_{calculated} > t_{(n-1, \alpha)}$ then the null hypothesis (H_0) is rejected at α% level of significance.

[α=0.05 or 0.01]

Results

Table 1: Effect of Vestibular Adaptation Exercises on Motion sickness on week 0-4

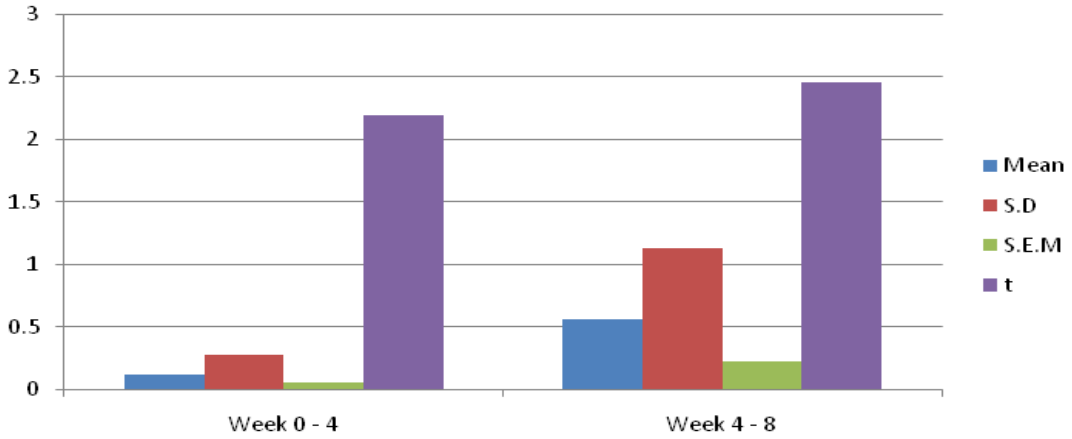
Effect of Vestibular Adaptation Exercises				
Improvement	**Mean**	**S.D**	**S.E.M**	**T**
Week 0 – 4	0.12	0.27	0.05	2.20

The't' test result shows that the difference between weeks 0-4 is less significant as the't' value is 2.20

Table 2: Comparison of Effect of Vestibular Adaptation Exercises on Motion sickness on week 0-4 and week 4-8

Effect of Vestibular Adaptation Exercises				
Relative Improvement	**Mean**	**S.D**	**S.E.M**	**T**
Week 0 – 4	0.12	0.27	0.05	2.20
Week 4 – 8	0.56	1.13	0.22	2.46

The't' test result shows that the difference between week 4-8 is significant as the 't' value is 2.46

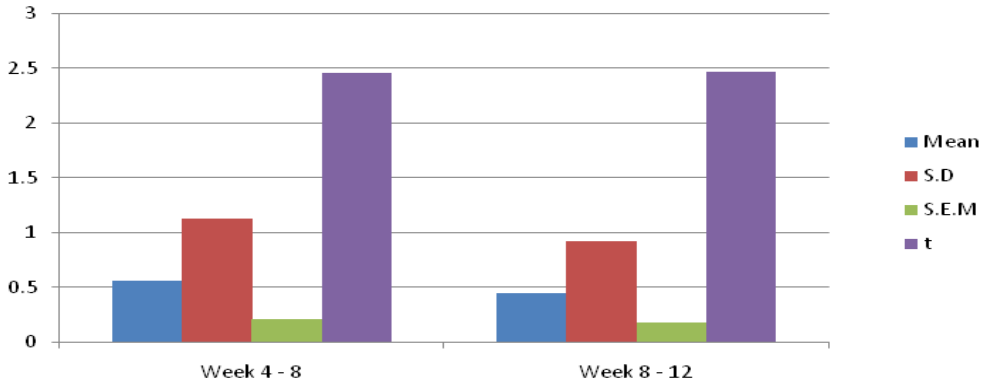


Graph 2: Comparison of MSSQ Scores from 0 – 4 weeks and 4 – 8 weeks

Table 3: Comparison of Effect of Vestibular Adaptation Exercises on Motion sickness on week 4-8 & week 8-12

Effect of Vestibular Adaptation Exercises				
Relative Improvement	**Mean**	**S.D**	**S.E.M**	**T**
Week 4 – 8	0.56	1.13	0.22	2.46
Week 8 – 12	0.45	0.92	0.18	2.47

The't' test result shows that the difference between week 4-8 & week 8-12 is significant as the 't' value is 2.47.

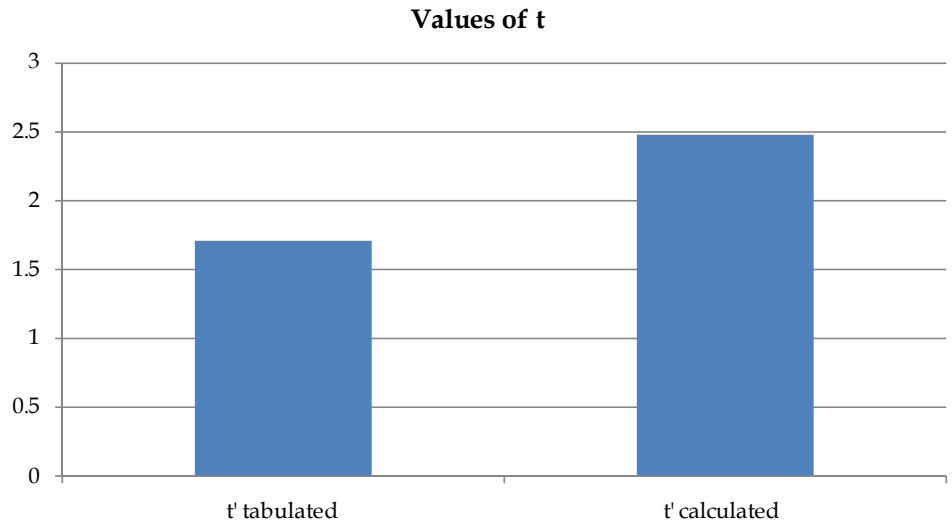


Graph 3: Comparison of MSSQ Scores from 4 – 8 weeks and 8 – 12 weeks

Table 4: Effect of Vestibular Adaptation Exercises on Motion sickness on week 0-12

Effect of Vestibular Adaptation Exercises				
Improvement	**Mean**	**S.D**	**S.E.M**	**T**
Week 0 - 12	1.14	2.29	0.45	2.48

The 't'test result shows that the difference between week 0-12 is significant as the 't' value is 2.48.
The above result shows that a significant difference is present between the readings of week 0 and week 12.



Graph 4: Comparison of 't'calculated and't' tabulated values

The value of $t_{calculated}$=2.48 is greater than value of $t_{24,0.05}$ = 1.711. So the null hypothesis (H_o) is rejected and the experimental hypothesis (H_1) is accepted.

In this study 25 subjects were included between 17-25 years of age, who were suffering from the sign and symptoms of the motion sickness. The score were measured before the application of the vestibular adaptation exercises and just after completion of vestibular adaption exercises for Total Duration of 40 min per session, Twice a day (40 + 40 min= 80 min per day) per week, for 12 weeks. The mean standard deviation (S.D) and standard error (S.E) are being calculated to perform the entire statistical data. The "t" test was used for analysis and the significant difference was calculated from the statistical data. The above all tables and graphs result shows that the 't' test difference between 0-4 week is less significant as the 't' value is 2.20, and the difference between 4-8 week is significant as the 't' value is 2.46, while the difference between week 4-8 & week 8-12 is significant as the 't' value is 2.47.After comparing the pre-experimental and post-experimental data we saw that the vestibular adaption exercises have the very significant value on motion sickness. Therefore, vestibular adaption exercises can be safely used to decrease the motion sickness.

Discussion

This study has shown that the effect of vestibular adaptation exercises on motion sickness. The vestibular adaptation exercises are most commonly used in the clinical and hospital settings and we intended to check their effects on motion sickness. This study has revealed that the methods which used in the study decrease the susceptibility to motion sickness which has led to improvement in the subjects.

A few researchers have done work where they have attempted to reduce signs and symptoms of motion sickness by giving vestibular adaptation exercises. An article by Rose Mary Rine, Michael Schubert and Thomas J Balkany describes physical therapy for motion sickness in a 34 year old woman. The purpose of the study was to describe the evaluation and treatment of a patient with motion sickness. The patient initially had moderate to severe visually induced motion sickness, which affected her function abilities. Following 10 weeks of a primary home based program of vestibular rehabilitation and balance training, her symptoms were decreased and she could resume all work-related activities[7].

The values of the motion sickness susceptibility questionnaire clearly shows that the vestibular adaptation exercises effectively reduce signs and symptoms of motion sickness. Therefore, vestibular adaption exercises can be safely used to reduce signs and symptoms of motion sickness in clinical and hospital settings and also for the home based programs.

Future Research

It is recommended that the future studies would be challenging if:-

1. The study is done for longer duration.
2. The advance regime of the vestibular adaptation exercises can also be included effectively which

can be useful in maintaining the interest of the subject in the activity.

3. The study can be done in the other age group.
4. The study can be done with the different group of gender.
5. The study can be done with other symptomatic subjects.
6. The number of subjects will be more, then the better conclusion can be made regarding the effectiveness of the treatment protocol.

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