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Effects of Vestibular Rehabilitation Using the Dizziness Handicap Inventory

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EFFECTS OF VESTIBULAR REHABILITATION USING
THE DIZZINESS HANDICAP INVENTORY

by

Nicholl Jurgens-Dinius
Bachelor of Science in Physical Therapy
University of North Dakota, 2000

An Independent Study

Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Physical Therapy

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2001



This Independent Study, submitted by Nicholl Jurgens-Dinius in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work had been done and is hereby approved.

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Thomas Moss
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PERMISSION

Title Effects of Vestibular Rehabilitation Using the Dizziness Handicap Inventory

Department Physical Therapy

Degree Master of Physical Therapy

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Date 11/28/00

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ABSTRACT

Vertigo, which may be caused by a variety of problems, is a significant symptom in patients with vestibular disorders. The Dizziness Handicap Inventory is a disease-specific questionnaire used to measure how vertigo affects an individual's quality-of-life. This study assessed patient outcomes following vestibular rehabilitation, using the Dizziness Handicap Inventory. Forty-nine former patients of a vestibular rehabilitation program participated in a phone survey following vestibular rehabilitation. Subjects answered the Dizziness Handicap Inventory based on how they felt before and after they had received physical therapy intervention. Patient outcomes were assessed by comparing Dizziness Handicap Inventory total and sub-scores before and after physical therapy intervention using the Sign test at the .05 alpha level. Statistically significant improvements in Dizziness Handicap Inventory total and sub-scores were determined following vestibular rehabilitation. A significant difference in score change was determined in 57% of the patients. The significant improvement in scores demonstrated that following vestibular rehabilitation, patient perceived outcomes improved. The Dizziness Handicap Inventory demonstrated to be useful to assess patient outcomes and can assist in making treatment goals and outcomes more patient focused and measurable.

CHAPTER I

INTRODUCTION

Vertigo, associated with vestibular disorders, is a significant health related problem.¹ In the United States, dizziness accounts for eight million primary care visits to physicians annually,² and is the number one reason for physician visits by people over the age of 65.³

Management and treatment of patients with vestibular problems is a challenge. The word "dizzy" is a generalized term used to describe a variety of sensations, including vertigo, disequilibrium, and light-headedness.³ Dizziness may be caused by a variety of problems, including vestibular pathology, medication, orthostatic hypotension, and somatosensory loss, as well as mental distress.³⁻⁵

Purpose

The purpose of this study is to determine the significant, long-term benefits in patients who have participated in a vestibular rehabilitation program by using the Dizziness Handicap Inventory (DHI).

Significance

The DHI has shown high reliability.⁴⁻⁶ The results from this study will benefit the practice of physical therapy by improving the evaluation and treatment of patients with vestibular disorders. By using the DHI, patient treatments and goals will

be more focused and measurable according to patient perceived problems. This will result in improved patient satisfaction, functional outcomes, and enhanced quality of life.

The results of this study will provide hope that both functional level and quality of life can be improved for patients with chronic vestibular disorders and support the implementation of vestibular rehabilitation for other patient populations, including the elderly.

Problem

The loss of function in one or more systems responsible for balance function is referred to as a vestibular disorder.³ Vestibular system disorders can produce a variety of signs and symptoms. Many signs and symptoms are the direct result of abnormalities in the vestibular system's ability to adapt and compensate to lesions affecting the vestibular nerve or central pathways.⁴ Symptoms of vertigo, past-pointing, nystagmus, and equilibrium disturbances are some of the major complaints of patients with partial or total destruction of the vestibular labyrinths. Other associated signs and symptoms related to vestibular system disorders include hearing loss, tinnitus, aural fullness, nausea, vomiting, and diaphoresis.^{2,3,5,7}

Vestibular disorders have been shown to affect health-related quality of life.² Vestibular symptoms can result in a cascade of physical and mental health handicaps, including emotional distress, anxiety, frustration, and decreased ability to perform activities of daily living and work.

A study performed by Cohen et al⁸ assessed the level of vertigo, gross-motor skills, and self care in patients with vestibular disorders, following a six-week

vestibular rehabilitation program. After participation in the study, patients had significant improvements in activities of daily living performance, indicating improved functional skills and relief of their vestibular symptoms.

An individual patient's vestibular rehabilitation outcomes can be measured by assessing changes in motion or position tolerance, balance, functional abilities, and health-related quality of life.^{2,3,7,9} Several measurement techniques are available to quantify vestibular symptoms, function of the vestibular system, and functional abilities of patients. Examples of these measurements include self-assessment, posturography, functional performance measures, the Borg dizziness index, video-oculography, and the Dizziness Handicap Inventory questionnaire (DHI).^{2,3,7,9,10}

Research Questions

1. Do DHI total scores change following vestibular rehabilitation in patients with mixed vestibular disorders?
2. Do DHI sub-scores (emotional, physical, and functional) change following vestibular rehabilitation in patients with mixed vestibular disorders?
3. Do answers consistently change to specific individual questions?

CHAPTER II

LITERATURE REVIEW

Anatomy

The vestibular system is made up of three components: a peripheral sensory apparatus, a central processor, and a mechanism for motor output.³ Angular velocity of the head, linear acceleration and head orientation in space are detected by a set of motion sensors, which are located in the peripheral sensory apparatus. The central nervous system (CNS) processes the motion sensor signals to estimate head orientation.

The peripheral vestibular system includes the membranous and bony labyrinths, along with the motion sensors.^{3,4} Located within the inner ear, the bony labyrinth, which contains perilymphatic fluid, consists of three semicircular canals and a central chamber called the vestibule. Membranous labyrinths, which contain endolymphatic fluid, are located within the bony labyrinths and contain five sensory organs. These organs are portions of the three semicircular canals and two otolith organs, the utricle and saccule. Each end of the semicircular canals widens in diameter to form an ampulla. No connection exists between the endolymph and perilymph compartments under normal circumstances.

Suspended in the ampulla and otolith organs are the specialized motion sensors, otherwise known as hair cells.^{3,4} They are located on the floor of the utricle and medial

wall of the saccule. Each individual hair cell is innervated by an afferent neuron, which excites the vestibular nerve when firing rate is increased in the neuron. Calcium carbonate crystals, called otoconia, are contained within the otolithic membranes, which cause the hair cells to be sensitive to gravity. A gelatinous membrane, called the cupula, is located in the ampullae.

Physiology

The vestibular system is responsible for sensing and controlling motion.⁴ Visual, somatosensory, and vestibular systems provide the main input to automatic postural reflexes and voluntary postural control. Vestibular signals are combined with information from the proprioceptive and visual system receptors to control balance and compensate for the effects of head motion. Eye and skeletal motor systems receive information from vestibular receptors to organize stabilizing reflexes.

The hair cell and otolith orientation allows them to respond to the direction of head movement.^{3,4} Movement of lymph, induced by head movement, deflects the cupulla and excites or inhibits hair cells in the ampulla, depending on the direction of lymphatic flow. The otoliths are responsible for detecting linear head acceleration and static tilt with respect to gravity.

The semicircular canals are responsive to head velocity and angular head motion.^{3,4} Head velocity is proportional to the rate of neural firing in the vestibular nerve, therefore, the semicircular canals are referred to as rate sensors. Angular head acceleration, at low and mid-frequency ranges, stimulate the semicircular canals. The semicircular canal alignment is matched by eye movement, which provides spatial alignment of reflexes.

The vestibular nerve transmits afferent signals from the labyrinths through the internal auditory canal (IAC), and terminates in the brain stem at the pontomedullary junction.³ The IAC also contains the cochlear nerve, which aids hearing, and the facial nerve, which is responsible for the sensation of taste.

Information from the semicircular canals and otoliths reach motor neurons in the spinal cord through three major pathways: lateral vestibulo-spinal tract, medial vestibulo-spinal tract, and the reticulo-spinal tract.⁴ Otolith postural reflexes are mainly controlled by the lateral vestibulo-spinal tract.³ The medial vestibulo-spinal tract is involved mainly in coordinating movement of the eyes and neck for gaze stabilization.⁴

The vestibular nuclear complex processes the afferent information and provides a communication network between the incoming afferent information and motor output neurons.³ Vestibular, somatosensory and visual sensory input is processed at the vestibular nuclear complex and cerebellum. The vestibular nuclear complex, cerebellum, brainstem reticular activating system, and ocular motor nuclei form connections to send appropriate efferent signals to the vestibulo-ocular reflex (VOR) and the vestibulo-spinal reflex (VSR) organs, along with the extraocular and skeletal muscles.

Vestibulo-ocular Reflex

The vestibular nuclear complex consists of four nuclei: superior, medial, lateral and descending.³ Superior and medial vestibular nuclei are relays for the VOR. The VOR is responsible for producing conjugate eye movements in the same plane as head motion. Conjugate eye movement is equal in magnitude, but opposite in direction to head movement.⁴ With proper VOR function, stable vision is maintained during head motion.

The VOR produces compensatory eye movement to help maintain gaze stability.^{3,11} Dysfunction of the VOR will cause head movements to produce retinal slip, decreased visual acuity, and gaze instability, resulting in poor postural stability and balance.

Vestibulo-spinal Reflex

The medial and lateral vestibular nuclei are in charge of the VSR.³ The VSR is primarily responsible for balance stability, gaze stabilization, and stabilization of the head and body. Head and eye movements are coordinated with the VSR by production of limb motion adjustments in relation to the position of the head on the body. The vestibulo-collic, tonic and dynamic labyrinthine reflexes are included as part of the vestibulo-spinal reflexes.

Cerebellum

The cerebellum not only interprets information from the vestibular nuclear complex, but also provides vestibular input.³ Vestibular reflexes become uncalibrated and ineffective without the cerebellum. Vestibulo-ocular reflex duration and gain are adjusted by the cerebellum. Profound gait ataxia and trunk instability are a result of cerebellar lesions resulting in VSR abnormalities. Lesions within the cerebellum produce gait ataxia and nystagmus, associated with head position with respect to gravity. Excessive alcohol intake and thiamine deficiencies are a common cause of cerebellar lesions in patients.

Vascular Supply

The peripheral and central nervous systems are vascularized by the vertebro-basilar arterial system.³ Branches of the vertebral arteries, called the posterior-inferior

cerebellar arteries, supply the inferior portions of the vestibular nuclear complex and the surface of the inferior cerebellar hemispheres. Perforator branches of the basilar artery supply the central vestibular structures.

The lower two-thirds of the pons, and the ventrolateral cerebellum are supplied via the anterior-inferior cerebellar arteries, which also supply the peripheral vestibular system via the labyrinthine artery.

Evaluation

A detailed patient history and description of vestibular signs and symptoms are gathered during an evaluation to assist in determining which systems and components are responsible for the patients symptoms.⁵ The initial episode may provide the most relevant information relative to the etiology.³ Intensity, duration, frequency of attacks, characteristics of symptoms, and factors that relieve or aggravate symptoms are helpful in determining the main cause of dizziness.

Specific events may predispose an episode of dizziness, such as food ingestion, sudden head or postural changes, exercise, coughing or sneezing.⁵ Sudden head or postural changes associated with vertigo, lasting seconds to a minute in duration, suggest Benign Paroxysmal Positional Vertigo (BPPV).

Most central or peripheral vestibular disorders are not associated with poor concentration, or light-headedness.^{3,5} Peripheral vertigo is severe, abrupt in onset, and usually associated with hearing loss and autonomic symptoms. Central causes of vertigo are more persistent and symptoms are moderate in comparison to peripheral vertigo.

Meniere's disease, hypotension, cardiovascular disease, and peripheral neuropathies are some disorders that may affect visual, somatosensory, or proprioceptive

system input, and may cause or contribute to a patient's complaint of dizziness.⁵

Psychological, metabolic, and CNS lesions may also cause vestibular system interruptions. Dizziness is also a common side effect of several medications and should be addressed in a vestibular evaluation.

The three major goals of a vestibular evaluation are to localize the site of the lesion, assess a patient's functional ability, and determine the degree of vestibular compensation.⁹ Sensory input, motor output, and neuronal pathways are evaluated to determine the elements involved in the production of the reported symptoms. Vestibular rehabilitation candidacy is determined by the degree of physiologic and functional vestibular compensation.

Vestibular Disorders

Vertigo can result from labyrinth or vestibular nerve pathology.⁹ Postural instability, disequilibrium, and oscillopsia are due to decreased vestibular eye movement or postural stability responses in relation to head movement.¹¹ Vestibular paresis, or the loss of vestibular hair cells or neurons, will decrease the vestibular response to head movement. Dysequilibrium results when the labyrinthine input produced by normal head movement is inappropriately determined due to an inhibited vestibular system.

Benign Paroxysmal Positional Vertigo is the most common, biomechanical disorder, which causes vertigo and dysequilibrium due to inappropriately excited semicircular canals.¹¹ Nystagmus occurs in the plane of the affected semicircular canal. Nystagmus begins 2-10 seconds following positional changes, fatigues 20-40 seconds later and is commonly associated with vertigo and nausea.⁴ Vertigo intensity will decrease with repeated movements into the symptom provoking position.

Positional nystagmus is a horizontal nystagmus, which is sustained throughout the duration of the onset position.⁴ It results from a misinterpretation of the brain of the translational-tilt ambiguity, where head tilts are mistaken as translations.

Vestibular Compensation

The vestibular system has plasticity and can adapt to incoming sensory information changes.⁶ Compensation strategies are necessary if a patient does not have vestibular system function. Visual and proprioceptive information will compensate, following bilateral and unilateral vestibular dysfunction, to stabilize gaze and maintain postural stability. Specific compensation mechanisms include alterations in saccadic eye direction and amplitude, central programming, visual tracking mechanisms, and limiting head movement and activity.¹¹ However, neither the visual or somatosensory mechanisms can stabilize balance at high frequencies.

Active neuronal changes in the cerebellum, brainstem, and opposite vestibular nuclei may compensate for sensory conflicts produced by a vestibular pathology.⁹ With a release of cerebellar inhibition, symmetric, tonic neural firing rates in the vestibular nuclei and accurate responses to head movement are reestablished to eliminate vertigo and dysequilibrium. Patients with vestibular dysfunctions may develop strategies based on prediction and anticipation of intended motor behavior. Maladaptive postural control strategies, which are destabilizing in certain settings, may be utilized by patients.

Abnormal vestibular organ input, decreased somatosensory stimuli, and an impaired CNS cause a disturbance in the compensation mechanisms, which will result in chronic symptoms of dizziness and imbalance.⁷ Long-term compensation must be achieved before motion-provoked vertigo is completely eliminated.⁹ The acute central

compensation mechanisms are enhanced by head movement and delayed by activity. Habituation will be highly unachievable if the lesion is unstable or if there are any preexisting or concurrent central vestibular dysfunctions.

Patients complaining of vestibular symptoms may have an active, primary vestibular disorder or symptoms resulting from poor CNS compensation following a previous vestibular lesion.⁹ Acute, severe vestibular onset, with persistent or reoccurring motion-provoked vertigo or continuous dysequilibrium, indicates uncompensation. A progressive dysfunction presents as a progression of symptoms over time, similar to or more severe than those at onset, along with spontaneous vertigo spells. Intense vertigo should only be experienced with head motion in patients with a non-progressive dysfunction. Central nervous system compensation extends over a long period of time. Therefore, patients may present with different symptoms, but have similar dysfunctions.

Symptomatic relapse may occur occasionally, even after the vestibular compensation process seems to be complete.⁹ A relapse of vestibular symptoms may be triggered by extreme fatigue, secondary illness, medication changes, or a period of inactivity. Periods of decompensation do not indicate progressive or ongoing labyrinthine dysfunction.

Medications may be prescribed to help decrease the symptoms of acute vertigo. Benzodiazepines, scopolamine, and meclizine are common medications that provide relief during the acute phase of labyrinthine dysfunction.⁹ All medications prescribed for vestibular disorders cause sedation and CNS depression, which counteract central vestibular compensation.^{9,12}

Vestibular Rehabilitation

Vestibular rehabilitation is appropriate in any condition where the vestibular deficit is stable, non-progressive, and the CNS compensation is incomplete.⁹ Patients with persistent symptoms of vestibular dysfunction are candidates for vestibular rehabilitation. Due to increased safety precautions, patients with maladaptive postural control strategies are considered prime candidates for vestibular rehabilitation. Vestibular rehabilitation is also a primary option for elderly patients with multifactorial balance problems.

Vestibular rehabilitation can reduce symptoms of chronic dizziness and imbalance in patients by assisting the compensation process. Central sensory substitution, physiologic habituation, and tonic activity adjustments within the vestibular center are hypothesized to occur as a result of vestibular rehabilitation.⁷

Vestibular rehabilitation goals are to assist patients in the management of vertigo and imbalance symptoms associated with vestibular disorders and to improve the patient's quality of life.² Vestibular rehabilitation programs can be individualized, and patient specific.⁶

Several studies provide evidence that vestibular rehabilitation is beneficial and effective in changes associated with a decrease or elimination of signs and symptoms in patients with vestibular disorders. Improvements have been documented in postural and dynamic stability, and functional abilities of patients. Konrad et al¹² states that vestibular rehabilitation should begin as soon as possible after the vestibular injury and must include head movements with vision in order to be the most effective. Gill-Body and Krebs et al¹³ study results demonstrate that after participation in individually

designed vestibular rehabilitation programs, two patients with distinctly different vestibular pathologies both had significant improvements in postural stability.

Vestibular Rehabilitation Exercises

Exercises that may be part of the integrated vestibular program may include repetitive head, eye, and body movements to decrease motion intolerance, and gaze instability and balance drills to reduce postural instability.⁶

Cawthorne and Cooksey^{3,7,13} initiated a vestibular rehabilitation program in the 1940s for patients with persistent dysequilibrium. The treatment program focused on vestibular adaptation. The vestibular system is trained to adapt to moving stimuli while head rotations are being performed. This approach is utilized most effectively in patients with unilateral or abnormal vestibular function.

Horak et al¹⁴ study results demonstrate improved postural stability, and reduced dizziness in patients with chronic, unilateral vestibular deficits, who performed vestibular exercises over a six week period in comparison to a group of patients who performed general conditioning exercises.

A substitution approach was designed for patients with no vestibular function.¹³ Compensation strategies, involving the use of visual and proprioceptive information, are taught to assist patients in gaze and postural stability. Vestibular substitution strategies may include combined head and eye movements, and body on head rotation during locomotion.

Krebs et al⁶ reported that after performing customized, balance and gait training exercises, and head and eye movement combination batteries, patients with chronic bilateral vestibular deficits had improved postural stability while walking and stair

climbing, and faster ambulation speed, when compared to patients who performed isometric and conditioning exercises.

Exercises incorporating both substitution and adaptation are utilized when the extent of central nervous system adaptation cannot be determined.¹³ This approach is used with patients with bilaterally reduced vestibular function.

Dizziness Handicap Inventory

The DHI is a 25-question self-assessment developed in 1990 by Jacobson and Newman.^{2,7,15} The inventory assesses a patient's perception of the impact of vestibular problems on several quality of life issues. It is comprised of three sub-sections, which focus on the emotional, functional, and physical impacts of vestibular dysfunction on a patient. The DHI specifically measures how vertigo and dysequilibrium affect an individual's quality of life.

The patient responds to each of the 25 questions with a "yes" (4 points), "sometimes" (2 points), or "no" (0 points) response.^{2,7,15} Score totals can range from 0 to 100 points. Greater perceived handicap and decreased quality of life are associated with higher scores. Each subscale receives a sub-score to determine the categories of perceived handicap.

Jacobson and Newman^{2,7} found the DHI test/retest reliability to be high, with a Pearson product correlation coefficient of $r = .97$. They also found that the DHI significantly correlated with computerized posturography tests. Higher DHI scores are associated with increased balance difficulties. Enloe and Shields² found that 55% of the variability in the scores for the DHI functional scale was accounted for by the DHI

emotional scale. Forty-five percent of the variability in the DHI functional scale was accounted for by the DHI physical scale.

Reports by Enloe and Shields² indicate that following vestibular rehabilitation programs, patients with vestibular disease had significantly improved DHI scores, and were closer to those of the normative general population.

Cowand et al⁷ conducted a study on the effects of vestibular rehabilitation in patients before and one year following therapy by using the DHI. Therapy exercises included gaze-stabilization, vestibular stimulation, balance, and proprioceptive training for a duration of 2 to 38 weeks. Seventy-eight percent of these patients were found to significantly improve after receiving vestibular rehabilitation. Complete resolution of dysfunction was found in 28% of these patients.

Mruzek et al¹⁵ studied the effects of vestibular rehabilitation on three groups of patients following ablative vestibular surgery by using dynamic posturography, assymetry index in rotation testing, and the DHI. One group performed active range of motion exercises in sitting to the shoulder, elbow, hip, knee, and ankle. The patients did not perform active range of motion exercises to the head or neck. The other two groups participated in a vestibular rehabilitation program, which consisted of habituation and balance exercises, and a daily walking program. One of these groups also received praise and encouragement for participation in the exercise program. DHI results indicated significantly less dizziness handicap in groups who received vestibular rehabilitation as compared to groups who performed range of motion exercise, as well as a more rapid and complete recovery.

CHAPTER III

METHODOLOGY

Subjects

Ninety-five adults who received outpatient vestibular rehabilitation in physical therapy between 1998 and 2000, by Maureen Landsberger MPT, at Altru Health Institute in Grand Forks, North Dakota, were contacted by telephone and asked to complete the Dizziness Handicap Inventory questionnaire. Forty-nine patients agreed to participate in the study. The participants' mean age was 60.6 years, ranging from 18-90 years.

Instrumentation

The DHI questionnaire was developed by Dr. GP Jacobson and Dr. CW Newman in 1990, and consists of questions that are related to dizziness and balance problems.^{2,7,15} Nine questions of the DHI are related to the emotional and functional sub-scales, and seven are related to the physical sub-scale. The DHI has a total of 100 points possible with 28 points coming from the physical sub-scale and 36 points from the emotional and functional sub-scales. Higher scores are associated with increased dizziness or unsteadiness.

Procedure

The purpose of the study was explained to each subject followed by an invitation to participate and a guarantee for patient confidentiality. Subjects were asked to answer

each question on the DHI. They provided responses for how they felt before physical therapy intervention (Pre-PT) and how they felt at the time of the telephone conversation (Post-PT) for each of the 25 dizzy-specific questions. Subjects were told to answer each question with a response of yes (4 points), sometimes (2 points), or no (0 points).^{2,7,15} All participants were informed that they could discontinue the phone interview at anytime if they wished. All telephone surveys were conducted by two University of North Dakota physical therapy graduate students. A copy of the phone interview and the DHI questionnaire can be found in appendix B.

Data Analysis

Total scores, percent total scores, sub-scores, percent sub-scores, and change in scores were calculated for each subject using the computer statistical program SPSS.¹⁶ The Wilcoxin two sample test and sign test, which are non-parametric statistical tests, were used to analyze if differences existed in total scores (Pre-PT & Post-PT), sub-scores (Pre-PT & Post-PT), and each individual question (Pre-PT & Post-PT) utilizing a .05 α level.¹⁷ The independent variable consisted of each subject and each individual question, whereas the dependent variable consisted of the total and sub-scores.

CHAPTER IV

RESULTS

The Wilcoxin two sample test was not reported due to multiple tie results.¹⁷ A significant difference was identified by the sign test between Pre-PT and Post-PT total DHI scores ($p < .001$). Fifty-seven percent (28/49) of the subjects had improvements in total DHI scores of greater than 18 points (see Figure 1). Each of the individual sub-scores was found to have significant Pre-PT and Post-PT differences ($p < .001$). See Table 1 for DHI outcomes.

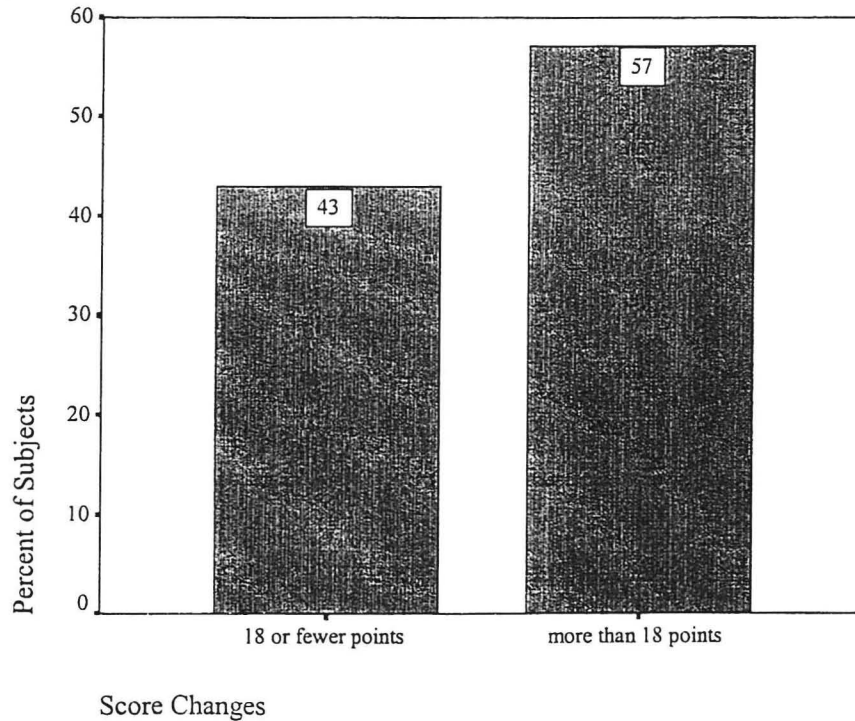


Figure 1. Percentage of subjects with score changes deviating from 18 points. Points greater than 18 show significant improvement in DHI scores following PT intervention.

Table 1. DHI Outcomes. DHI score changes, z-scores and probabilities of the 49 subjects following physical therapy intervention.

	PHYSICAL	EMOTIONAL	FUNCTIONAL	TOTAL
Improved ^a	42	34	41	43
Decrease ^b	0	2	0	2
No Change ^c	7	13	8	4
n	49	49	49	49
z-score	-6.326	-5.167	-6.247	-5.963
p	< 0.001 ^d	< 0.001 ^d	< 0.001 ^d	< 0.001 ^d

- a. Score after treatment lower than score before treatment
- b. Score before treatment lower than score after treatment
- c. No change in score
- d. Significant difference

Two out of the 25 DHI questions did not demonstrate a significant difference in Pre-PT and Post-PT scores. Question 20 (p=.250) and Question 22 (p=.063) of the DHI questionnaire did not demonstrate a significant difference in Pre-PT and Post-PT answers. See Appendix C for specific DHI questions and outcomes to each question following physical therapy intervention.

CHAPTER IV

DISCUSSION AND CONCLUSION

The results of our study demonstrate that 43 patients improved in total DHI scores. Four subjects had no change in scores and two subjects had decreased results. Literature states that greater than eighteen points of improvement in the total DHI scores demonstrate significant results.⁷ Twenty-eight subjects (57%) had a significant improvement in their total DHI score. There were no literature statements found in regards to a significant point change for the DHI sub-scales. Further research to determine a significant point change for each sub-scale would be beneficial.

It is interesting to note that questions 20 and 22 of the DHI demonstrated no significant difference in scores and both are a part of the emotional sub-scale. Question 20 of the DHI states "Because of your problem, are you afraid to stay home alone?" and question 22 states "Has your problem placed stress on your relationships with members of your family or friends?" This relationship may be related to embarrassment of the subjects or because many people do not want to address, discuss, or admit personal problems, especially when the questions are asked by complete strangers.

The two subjects with decreased outcome results following vestibular rehabilitation each declined in emotional sub-scores, however, their functional and physical sub-scores remained the same. It appears that with increased time duration

following the patient's dizziness onset, emotional factors seem to become an increasing concern when treating a patient with persistent dizziness.

This study had results similar to another study performed by Cowand et al.⁷ This study indicated that following vestibular rehabilitation, 35% of the subjects demonstrated significant improvement in their total DHI scores. DHI sub-scores illustrated significant changes in the patient's dizziness perceptions in the physical and functional sub-scores without a significant change in the emotional sub-scale scores.

Vestibular rehabilitation may not benefit all patients with vestibular problems, physically or functionally, however, physical therapists can address emotional issues of patients in an attempt to improve other aspects related to quality of life.

Limitations

All patients were chosen from one facility with several surrounding rural communities, therefore, the sample may not represent the general population. It would be beneficial in future studies to compare rural facility outcomes with urban facility outcomes to determine if differences exist.

The survey was conducted by two callers, which may have effected the study results. Even though the phone survey was standardized, the responses may have been different due to inconsistency in the callers tone of voice and style the questions may have been delivered over the phone.

The ages of the patients who received vestibular rehabilitation broadly ranged from 18-90 years. The elderly subjects may have had secondary medical complications along with previously compromised vestibular and somatosensory systems, which may have suppressed the vestibular rehabilitation process. The patient's previously existing

medical problems may have made a specific, and accurate vestibular dysfunction diagnosis impossible, which may make vestibular rehabilitation treatment difficult and consequently effect outcomes.

Another limitation of this study was that outcomes of patients with BPPV and patients with mixed vestibular deficits were compared together rather than separated by diagnosis. Current research states that patients with BPPV tend to have a better outcome following vestibular rehabilitation compared to patients with mixed vestibular deficits. Since vestibular rehabilitation outcomes were not separated by diagnosis, the results of this study may have been different. It would be beneficial in future studies to compared the two diagnoses when determining outcome results.

The influence of gender differences was not considered when determining the vestibular rehabilitation outcomes. Future studies should address male versus female influences on study outcomes, especially when comparing the physical, emotional, and functional sub-scores.

The participants of this study were not asked if they were instructed in a home exercise program during vestibular rehabilitation or about their current activity level. The effectiveness of a home exercise program and related compliance issues in patients with vestibular dysfunctions should be a focus for future studies.

All of the subjects in this study received one-on-one therapy by the same physical therapist. The consistency in therapy may have been a factor in the outcomes of this study due to differences in technique and style between therapists.

Other factors, which may have affected the study results, were the amount of time between therapy cessation and the DHI survey administration. It may be possible, that

with increase time duration, patients may have had a reduction in their dizziness signs and symptoms. The individual answers were also dependent on each subject's ability to recall how they felt after treatment. The influence of any prescription or over-the-counter medications was also not taken into account during this study.

Conclusion

This group of 49 patients with vestibular dysfunctions had statistically significant improvements in DHI scores following vestibular rehabilitation. Of the participants, 43 patients had improvements in total DHI scores, while 28 of these subjects had a significant improvement.

It is important that the physical therapists involved in vestibular rehabilitation have a thorough understanding of the anatomy and physiology of the vestibular system, along with the corresponding complex vestibular disorders. Physical therapists must understand the complexity of vestibular dysfunctions and the resultant compensatory mechanisms of the body, and be competent in specialized evaluation and treatment skills in order to provide effective and efficient vestibular rehabilitation.

The DHI can be utilized by physical therapists to assist in their evaluation, direct treatment toward patient perceived problems, and to assess treatment outcomes.

The study results support the implementation of vestibular rehabilitation in patients with various vestibular disorders. The patient perceived quality of life for many patients in this study was improved after they had received vestibular rehabilitation.

APPENDIX A

EXPEDITED REVIEW REQUESTED UNDER ITEM (NUMBER[S]) OF HHS REGULATIONS
 EXEMPT REVIEW REQUESTED UNDER ITEM 2 (NUMBER[S]) OF HHS REGULATIONS

UNIVERSITY OF NORTH DAKOTA HUMAN SUBJECTS REVIEW FORM
FOR NEW PROJECTS OR PROCEDURAL REVISIONS TO APPROVED
PROJECTS INVOLVING HUMAN SUBJECTS

Please include ALL information and check ALL blanks that apply.

PRINCIPAL INVESTIGATOR: Jayme M. Bays & Nicholl Jurgens-Dinius TELEPHONE: 777-9782 DATE: 4/10/00

ADDRESS TO WHICH NOTICE OF APPROVAL SHOULD BE SENT: #3717 Berkeley Dr Grand Forks, ND 58203

SCHOOL/COLLEGE: Health Sciences DEPARTMENT: Physical Therapy PROJECT DATES: 4/00 to 5/01
(E.g., A&S, Medicine, EHD, etc.) (Month/Day/Year)

PROJECT TITLE: Effects of Vestibular Rehabilitation Using the Dizziness Handicap Inventory

FUNDING AGENCIES (IF APPLICABLE):

TYPE OF PROJECT (Check ALL that apply):
 NEW PROJECT CONTINUATION RENEWAL DISSERTATION OR THESIS RESEARCH STUDENT RESEARCH PROJECT
 CHANGE IN PROCEDURE FOR A PREVIOUSLY APPROVED PROJECT

DISSERTATION/THESIS ADVISER, OR STUDENT ADVISER: Cindy Flom-Meland MPT

PROPOSED PROJECT: INVOLVES NEW DRUGS (IND) INVOLVES NON-APPROVED USE OF DRUG INVOLVES A COOPERATING INSTITUTION

IF ANY OF YOUR SUBJECTS FALL IN ANY OF THE FOLLOWING CLASSIFICATION, PLEASE INDICATE THE CLASSIFICATION(S):

MINORS (<18 YEARS) PREGNANT WOMEN MENTALLY DISABLED FETUSES PERSONS WITH
 PRISONERS ABORTUSES UND STUDENTS (>18 YEARS)

IF YOUR PROJECT INVOLVES ANY HUMAN TISSUE, BODY FLUIDS, PATHOLOGICAL SPECIMENS, DONATED ORGANS, FETAL MATERIAL, OR PLACENTAL MATERIALS, CHECK HERE

IF YOUR PROJECT HAS BEEN/WILL BE SUBMITTED TO ANOTHER INSTITUTIONAL REVIEW BOARD(S), PLEASE LIST NAME OF BOARD(S): Altru Health Institute

Status: Submitted; Date 4-19-00 Approved; Date Pending

1. ABSTRACT: (LIMIT TO 200 WORDS OR LESS AND INCLUDE JUSTIFICATION OR NECESSITY FOR USING HUMAN SUBJECTS.)

The purpose of this study is to investigate patient outcomes after participating in a physical therapy vestibular rehabilitation program. Former Altru physical therapy vestibular rehabilitation outpatients will be contacted by phone and asked to answer questions to the Dizziness Handicapped Inventory (DHI). The DHI is a standardized dizzy-specific, questionnaire used to quantify the impact of dizziness on quality of life. It aims at measuring emotional, physical, and functional capabilities in individuals and is commonly used to measure changes after clinical intervention. Answers to each question will be scored and evaluated to determine the effectiveness of vestibular rehabilitation. Results from this survey will further improve vestibular physical therapy evaluation and treatment options resulting in

PLEASE NOTE: Only information pertinent to your request to utilize human subjects in your project or activity should be included on this form. Where appropriate attach sections from your proposal (if seeking outside funding).

2. PROTOCOL: (Describe procedures to which humans will be subjected. Use additional pages if necessary. Attach any surveys, tests questionnaires, interview questions, examples of interview questions (if qualitative research), etc., the subjects will be asked to complete.

Subjects: Subjects will consist of outpatients treated for vestibular dysfunction at Altru Health Institute by Marreen Landsberger MPT from 1998 to the present.

Survey: The survey will consist of the DHI questionnaire developed by Dr. GP Jacobson and Dr. CW Newman in 1990. It consists of questions are related to dizziness and balance problems. These questions should not be surprising to the subjects for many of the questions were part of the routine physical therapy vestibular evaluation. This survey will be conducted by phone and will be completely voluntary.

Procedures: A list of former vestibular rehabilitation outpatient names and phone numbers will be collected. Each subject will be contacted by phone and asked to participate in this study. The names and phone numbers of each subject will be kept confidential and will be destroyed immediately following collection of the data. The survey will be completely voluntary and each subject will have the right to refuse to participate if desired. The completed surveys will be kept in a locked file in the University of North Dakota department of Physical Therapy for 3 years, whereby they will then be destroyed. A copy of the survey is included at the end of this form.

Data Analysis: The investigators will examine the compiled responses from the surveys. The use of traditional descriptive and analytical statistics, with the use of the computer program SPSS, will be used to determine the results. A set alpha level of 0.05 will be used for all statistical analysis.

Data Reported: All results from this study will be reported to Altru Health Institute and the University of North Dakota Department of Physical Therapy. Results will also be available for the public to view.

References for Survey:

Enloe Lori J., Shields Richard K. Evaluation of health-related quality of life in individuals of health-related quality of life in individuals with vestibular disease using disease specific and general outcome measures. Phys Ther. 1997;77(9);890-903.

<http://www.cscd.nwu.edu/public/balance/dizzy.cfm>

Coward Jennifer L., MS, PT, Wristly Diane M., PT, NCS, Walker Martha, MS, PT, Strasnick Barry, MD, and Jacobson John T., PhD. Efficacy of vestibular rehabilitation. Otolaryngol Head Neck Surg. 1998;118:49-54.

3. BENEFITS: (Describe the benefits to the individual or society.)

Benefits: The DHI has been shown to be highly reliable, and results from this questionnaire will benefit the practice of physical therapy by improving the evaluation and treatment process. By using the DHI, physical therapy treatments and goals will be more focused and measurable according to patient perceived problems. This will ultimately result in improved patient satisfaction, functional outcomes, and enhanced quality of life.

4. RISKS: (Describe the risks to the subject and precautions that will be taken to minimize them. The concept of risk goes beyond physical risk and includes risks to the subject's dignity and self-respect, as well as psychological, emotional or behavioral risk. If data are collected which could prove harmful or embarrassing to the subject if associated with him or her, then describe the methods to be used to protect the confidentiality of data obtained, debriefing procedures, storage of data, how long data will be stored (must be a minimum of three years), final disposition of data, etc.)

Risks: There are minimal risks involved in this study. Some of the questions asked on the DHI might result in embarrassment for the subjects. However, most of the questions should be familiar from their initial physical therapy evaluation and should not be surprising. Participation is voluntary and all surveys will remain anonymous and confidential. The names and phone numbers of the subjects will be kept confidential and will be destroyed immediately following the collection of the data. All surveys will be kept in a locked file in the University of North Dakota Department of Physical Therapy for 3 years, whereby they will then be destroyed.

5. **CONSENT FORM:** Attach a copy of the **CONSENT FORM** to be signed by the subject (if applicable) and/or any statement to be read to the subject should be attached to this form. If no **CONSENT FORM** is to be used, document the procedures to be used to assure that infringement upon the subject's rights will not occur.

Describe where signed consent forms will be kept and for how long (must be a minimum of 3 years), including plans for final disposition or destruction.

Consent Form: There will not be a formal consent form used for this study. Each participant will receive a phone call explaining the purpose of the study. Oral completion of the DHI questionnaire will be regarded as the subject's informed consent. The surveys will be kept for three years and then destroyed.

6. For **FULL IRB REVIEW** forward a signed original and fifteen (15) copies of this completed form, including fifteen (15) copies of the proposed consent form, questionnaires, examples of interview questions, etc. and any supporting documentation to the address below. An original and 19 copies are required for clinical medical projects. In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form if the proposal is non-clinical; 7 copies if the proposal is clinical medical. If the proposed work is being conducted for a pharmaceutical company, 7 copies of the company's protocol must be provided.



Office of Research & Program Development
University of North Dakota
Grand Forks, North Dakota 58202-7134

On campus, mail to: Office of Research & Program Development, Box 7134, or drop it off at Room 105 Twamley Hall.

For **EXEMPT** or **EXPEDITED REVIEW** forward a signed original, including a copy of the consent form, questionnaires, examples of interview questions, etc. and any supporting documentation to one of the addresses above. In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form.

The policies and procedures on Use of Human Subjects of the University of North Dakota apply to all activities involving use of Human Subjects performed by personnel conducting such activities under the auspices of the University. No activities are to be initiated without prior review and approval as prescribed by the University's policies and procedures governing the use of human subjects.

SIGNATURES:

 Principal Investigator	4-19-00 Date
 Project Director or Student Adviser	4-19-00 Date
Training or Center Grant Director	Date

STUDENT RESEARCHERS: As of June 4, 1997 (based on the recommendation of UND Legal Counsel) the University of North Dakota IRB is unable to approve your project unless the following "Student Consent to Release of Educational Record" is signed and included with your "Human Subjects Review Form."

STUDENT CONSENT TO RELEASE OF EDUCATIONAL RECORD¹

Pursuant to the Family Educational Rights and Privacy Act of 1974, I hereby consent to the Institutional Review Board's access to those portions of my educational record which involve research that I wish to conduct under the Board's auspices. I understand that the Board may need to review my study data based on a question from a participant or under a random audit. The study to

which this release pertains is

the effects of vestibular rehabilitation using
the dizziness Handicap Inventory.

I understand that such information concerning my educational record will not be released except on the condition that the Institutional Review Board will not permit any other party to have access to such information without my written consent. I also understand that this policy will be explained to those persons requesting any educational information and that this release will be kept with the study documentation.

Date 4/19/00

Nicholas Augusto-Dinudo, PT
Signature of Student Researcher

¹Consent required by 20 U.S.C. 1232g.



Institutional Review Board Research Project Action Report

Date: May 31, 2000 IRB # PT-014
Principal Investigator: Jayme Bays & Nicholl Dinius Department: Physical Therapy-UND Phone #: 777-9782
Address to which notice of approval should be sent: #3717 Berkeley Dr., Grand Forks ND 58203

Research Coordinator: Same as above Phone # 777-9782

Project Title: Effects of Vestibular Rehabilitation Using the Dizziness Handicap Inventory

The above referenced project protocol and informed consent was reviewed by the Altru Health System Institutional Review Board on _____ and the following action was taken:

- Project approved. Next Scheduled review is on _____
If no date is given, then review will be required in 12 months. (See REMARKS SECTION for any special condition.)
- Project approved. EXPEDITED REVIEW NO. _____
Next scheduled review is on _____
- Project approved. EXEMPT CATEGORY NO. 2
No periodic review scheduled unless so stated in **REMARKS SECTION**.
- Project approval deferred. (See **REMARKS SECTION** for further information.)
- Project denied. (See **REMARKS SECTION** for further information.)
- Amendment approved
- Administrative change approved
- Protocol revision approved
- Revised consent form approved
- Adverse event reviewed - Date of event _____
- Other _____

REMARKS:

Any changes in protocol, adverse occurrences or deaths in the course of the research project must be reported immediately to the IRB chairperson or the IRB office (780-6161).

Signature of Chairperson or Designated IRB Member
Altru Health System Institutional Review Board

Date 6/5/00

If the proposed project is to be part of a research activity funded by a federal agency, a special assurance statement or a completed 596 Form may be required. Contact IRB office to obtain the required documents.

LEAD IRB DESIGNATION SHEET

I have reviewed the proposal received from Jayne M. Bays and Nicholl Jurgens-Dinius

Department of Physical Therapy (College of Medicine

University of North Dakota) entitled "Effects of Vestibular Rehabilitation Using the Dizziness Handicap

Inventory and recommend that the Altru Health System Institutional Review
 University of North Dakota

Board be the lead IRB because subjects will be accrued at their institution.

Warren C. Jensen

Warren C. Jensen, Chair
University of North Dakota
Institutional Review Board

4/26/00

Date

Kevin J. Tveter

Kevin J. Tveter, M.D., Chair
Altru Health Systems
Institutional Review Board

5/9/00

Date



VESTIBULAR REHAB OUTCOME SURVEY

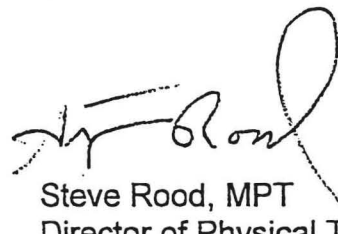
The vestibular system is housed in the inner ear. It works in conjunction with your visual and sensory systems to control your balance and orientation to space.

The Altru Health Institute has a vestibular rehabilitation program that evaluates and treats patients with vestibular dysfunctions. The physical therapist that treats these patients is Maureen Landsberger, MPT. She can be contacted at 780-2315. Steve Rood, MPT, Physical Therapy Director can also be reached at this number.

Altru will be working with graduate physical therapy students from the University of North Dakota to conduct a vestibular rehab research project. The project is designed to interpret outcomes of vestibular rehab. Patients will be contacted via phone and asked a series of questions related to balance and dizziness. Patients will be assured of the confidentiality of their identity and the answers given.

Questions regarding the study can be addressed by the UND students involved (UND 777-2831) or the above mentioned clinicians.


Maureen Landsberger, MPT


Steve Rood, MPT
Director of Physical Therapy
Altru Health System

APPENDIX B

Phone Interview

Introduction:

Hello, this is Nicholl Jurgens/Jayne Bays, and I am a physical therapy student at the University of North Dakota. I am currently conducting a study for Maureen Landsberger. She is a physical therapist at Altru Health Institute in Grand Forks. The purpose of this study is to look at patient outcomes following physical therapy. I understand that you were a patient of Maureen's, and I was wondering if you would be interested in taking a few minutes to answer some questions related to our study on vestibular rehabilitation. (Wait for a response)

The questions I am going to ask you come from a standardized questionnaire called the Dizziness Handicap Inventory. It is a series of 25 questions based on symptoms associated with dizziness. Your participation in this study will remain confidential, and you may discontinue at anytime if you do not wish to continue answering the questions. Is it alright for me to continue?

With each question asked, I would like you to answer with either yes, no, or sometimes for both how you felt before and after therapy. (Ask the 25 questions)

Closing:

I would like to sincerely thank you for taking time to participate in this study. The results of this study will be made available to the public upon completion. Again thank you for your time.

Dizziness Handicapped Inventory Questionnaire

Dizziness Handicapped Inventory Questions.	Before	After
1. Does looking up increase your problem?	Yes Sometimes No	Yes Sometimes No
2. Because of your problem, do you feel frustrated?	Yes Sometimes No	Yes Sometimes No
3. Because of your problem, do you restrict your travel for business or recreation?	Yes Sometimes No	Yes Sometimes No
4. Does walking down the aisle of a supermarket increase your problem?	Yes Sometimes No	Yes Sometimes No
5. Because of your problem, do you have difficulty getting into or out of bed?	Yes Sometimes No	Yes Sometimes No
6. Does your problem significantly restrict your participation in social activities such as going out to dinner, going to movies, dancing or to parties?	Yes Sometimes No	Yes Sometimes No
7. Because of your problem, do you have difficulty reading?	Yes Sometimes No	Yes Sometimes No
8. Does performing more ambitious activities like sports, dancing, household chores such as sweeping or putting dishes away increase your problem?	Yes Sometimes No	Yes Sometimes No
9. Because of your problem, are you afraid to leave your home without having someone accompany you?	Yes Sometimes No	Yes Sometimes No
10. Because of your problem, have you been embarrassed in front of others?	Yes Sometimes No	Yes Sometimes No
11. Do quick movements of your head increase your problem?	Yes Sometimes No	Yes Sometimes No
12. Because of your problem, are you afraid of heights?	Yes Sometimes No	Yes Sometimes No
13. Does turning over in bed increase your problem?	Yes Sometimes No	Yes Sometimes No
14. Because of your problem, is it difficult for you to do strenuous housework or yardwork?	Yes Sometimes No	Yes Sometimes No

Dizziness Handicapped Inventory Questions.	Before	After
15. Because of your problem, are you afraid people may think you are intoxicated?	Yes Sometimes No	Yes Sometimes No
16. Because of your problem, is it difficult for you to walk by yourself?	Yes Sometimes No	Yes Sometimes No
17. Does walking down a sidewalk increase your problem?	Yes Sometimes No	Yes Sometimes No
18. Because of your problem, is it difficult for you to Concentrate?	Yes Sometimes No	Yes Sometimes No
19. Because of your problem, is it difficult for you to walk around your house in the dark?	Yes Sometimes No	Yes Sometimes No
20. Because of your problem, are you afraid to stay home alone?	Yes Sometimes No	Yes Sometimes No
21. Because of your problem, doe you feel handicapped?	Yes Sometimes No	Yes Sometimes No
22. Has your problem placed stress on your relationships with members of your family or friends?	Yes Sometimes No	Yes Sometimes No
23. Because of your problem, are you depressed?	Yes Sometimes No	Yes Sometimes No
24. Does your problem interfere with your job or household responsibilities?	Yes Sometimes No	Yes Sometimes No
25. Does bending over increase your problem?	Yes Sometimes No	Yes Sometimes No

APPENDIX C

Dizziness Handicapped Inventory Questionnaire and Outcomes Following Physical Therapy

Dizziness Handicapped Inventory Questions.	Improved	Decreased	No Change	n
1. Does looking up increase your problem?	26	0	23	49
2. Because of your problem, do you feel frustrated?	27	1	21	49
3. Because of your problem, do you restrict your travel for business or recreation?	15	0	34	49
4. Does walking down the aisle of a supermarket Increase your problem?	17	0	32	49
5. Because of your problem, do you have difficulty Getting into or out of bed?	30	0	19	49
6. Does your problem significantly restrict your participation in social activities such as going out to dinner, going to movies, dancing or to parties?	17	0	32	49
7. Because of your problem, do you have difficulty reading?	10	0	39	49
8. Does performing more ambitious activities like sports, dancing, household chores such as sweeping or putting dishes away increase your problem?	27	0	22	49
9. Because of your problem, are you afraid to leave your home without having someone accompany you?	12	0	37	49
10. Because of your problem, have you been embarrassed in front of others?	7	0	42	49
11. Do quick movements of your head increase your Problem?	37	0	12	49
12. Because of your problem, are you afraid of heights?	17	0	32	49
13. Does turning over in bed increase your problem?	29	0	20	49

Dizziness Handicapped Inventory Questions.	Improved	Decreased	No Change	n
14. Because of your problem, is it difficult for you to do strenuous housework or yardwork?	26	0	23	49
15. Because of your problem, is it difficult for you to walk by yourself?	13	0	36	49
16. Does walking down a sidewalk increase your problem?	13	0	36	49
17. Because of your problem, is it difficult for you to concentrate?	12	0	37	49
18. Because of your problem, is it difficult for you to walk around your house in the dark?	11	0	38	49
19. Because of your problem, are you afraid to stay home alone?	3	0	46	49
20. Because of your problem, do you feel handicapped?	14	1	34	49
22. Has your problem placed stress on your relationships with members of your family or friends?	5	0	44	49
23. Because of your problem, are you depressed?	14	0	35	49
24. Does your problem interfere with your job or household responsibilities?	26	0	23	49
25. Does bending over increase your problem?	28	0	21	49

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13. Gill-Body KM, Krebs DE, Parker SW, O'Riley P. Physical therapy management of peripheral vestibular dysfunction: two-clinical case reports. *Phys Ther.* 1994;74:129-142.
14. Horak FB, Jones-Rycewicz C, Black FO, Shumway-Cook A. Affects of vestibular rehabilitation on dizziness and imbalance. *Otolaryngol Head & Neck Surg.* 1992;106:175-180.
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