

Current Rationales for Vestibular Rehabilitation and Balance Therapies

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Background

People referring to vestibular therapies often include a wide variety of treatment approaches ranging from adaptation and habituation exercises to strengthening and functional mobility or gait training. For our purposes, rehabilitation treatment protocols focused on retraining involving primarily cortical, brainstem, oculomotor, and peripheral vestibular systems (“above the neck”) are referred to as vestibular therapy techniques and those focused on neuromuscular systems (“below the neck”) are referred to as balance therapy techniques.

The goals associated with these treatments range from reducing or eliminating dizziness to stabilizing vision and improving static and dynamic balance in order to prevent and/or reduce falls. Specific therapy approaches are chosen based on evaluative results of the Vestibular Autorotation Test (VAT), electronystagmography (ENG), and posturography testing. The treatments are designed to alleviate patient symptoms and address the source of the problem in order to restore and maintain long-term function. Since most balance and/or vestibular problems are multifactorial, no therapy approach is exclusive. A combination of both vestibular and balance protocols are commonly utilized to achieve the desired results.

It should also be noted that, in today’s healthcare environment, we are increasingly using objective measures to diagnose, treat, and provide outcome measures of patient improvement. Objective measures have been shown to be more effective in identifying patients with difficulties, identifying the site of lesion, and providing quantified outcome measures for our medical record-keeping and payment negotiations. These devices and measures will be referred to periodically throughout this paper.

Fall-Risk Related Problems and Therapies

According to the Center for Disease Control (CDC), falls are the leading cause of injury deaths and the most common cause of nonfatal injuries and hospital admissions for trauma. More than 1.6 million older adults were treated in emergency departments for fall-related injuries and nearly 388,000 were hospitalized in 2001. Those people 75 years and older who fall are four to five times more likely to be admitted to a long-term care facility¹.

Traditional evaluations for fall risk have been conducted through physical examination by the primary care physician and often referred on for a physical therapist evaluation. Current technology and knowledge allows audiologists and medical specialties to identify patients that are at increased risk for falls even though they may not display overt symptoms. It is estimated that the number of falls and the consequences resulting from falls can be drastically reduced by addressing both identifiable and symptomatic patient problems.

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Once a patient has been screened and is identified as being at risk for falling, the next step should be to perform a thorough vestibular function history and physical examination so accurate information can be disseminated when the patient is referred to the physical therapist. Once seen for the initial evaluation by the physical therapist, an appropriate plan of care can then be developed. It should be noted that not all physical therapists are proficient in treating patients with vestibular issues, and additional training is necessary for effective patient treatment. Treatments that may be included in the plan of care, based on their findings, are vestibular-ocular reflex (VOR) exercises, adaptation exercises, habituation exercises, balance training, as well as lower extremity stretching and strengthening trunk stabilization and gait and mobility training. Age related changes in reaction time, flexibility, strength and visual stabilization and/or proprioception may or may not be neurologic in nature.

Many inherent problems will be evident during an initial assessment on a balance platform. As therapy treatments progress, patients will show improvement on tests such as limits of stability, weight bearing, and other tests that focus on the somatosensory, vestibular and visual systems. It should also be noted, however, that all these problems also require long-term solutions. Although a patient's performance will generally improve significantly following weeks of therapy, it is important to continue the exercise program provided by the physical therapist in order to maintain independent activities of daily living. This exercise program is often a life-long commitment.

Oculomotor Dysfunction and Therapy

Oculomotor deficits may be the most common vestibular problem in older adults. Based on a review of electronystagmography (ENG) tests on patients referred from primary care physicians, a decrease in smooth pursuit (slower, continual tracking of an object) and saccadic eye movements (rapid change in visual target from one object to another) are some of the most common abnormal vestibular findings. These problems may occur in conjunction with other findings, usually neurological, or by the sole abnormality. They may arise from strokes, head traumas, neurological disorders or diseases, mass lesions, or even weaknesses (degeneration?) of the cerebellum, oculomotor nerve, and/or musculature of the eyes.

Oculomotor dysfunction can be severe enough to observe with the professional's eyes alone using informal tracking maneuvers. However, many patients demonstrate deficits that can only be diagnosed through use of more sensitive ENG equipment. Because an ENG evaluation is largely a series of functional tests, it also serves as a good outcome measure. Following vestibular therapies of the oculomotor system, a patient's performance on oculomotor tests should show improvement.

Treatments to address oculomotor deficits typically consist of exercises to task and strengthen the affected systems. For example, a patient demonstrating reduced smooth pursuit would be given pursuit tasks to perform. These may include exercises in which the patient moves a hand-held object back and forth in front of her and follows the object with her eyes (keeping the head still). A complimentary exercise in which the head is moved while maintaining a fixed gaze on an object may also be used. By performing these exercises, the patient is increasing strength and mobility of the oculomotor system which is not unlike the exercises used to increase strength and mobility of the lower extremities. These treatment examples should increase visual stabilization ability thus improving balance.

Habituation Therapy

Many vestibular disorders arise from conditions that cannot be directly treated. Such disorders may include Meniere's disease, trauma-related disorders of the vestibular labyrinth, brainstem, or

cortex, and some stroke-related lesions. These problems may manifest in a variety of ways on VOR and ENG testing, including unilateral caloric weakness, positional vertigo, VOR deficits, and even certain oculomotor deficits. In some cases, such as Meniere's Disease, the disorder may be somewhat controlled through alteration of diet and lifestyle. In many cases, however, no treatment may have a positive effect. In these cases, therapy is used to retrain the patient's vestibular processing at a cortical and subcortical level so that a "new normal" is established and symptoms subside.

In these cases, the underlying theory is to work the affected system and help the patient's brain learn to recognize the altered sense of motion through afferent pathways and relate the new input to the associated motion. In this way, this is not unlike a patient with cochlear implants learning to recognize and interpret sounds that are severely distorted compared to a normal functioning auditory system. In these instances, a patient's dizziness typically arises from an ongoing inhibition (usually) of vestibular input or conflicting input from left and right sides. In time, the dizziness subsides as the brain develops a new template to interpret sensations of motion.

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Positional Vertigo and Canalith Repositioning Maneuvers

Although there are many types of positional vertigo, the most common by far is Benign Paroxysmal Positional Vertigo (BPPV), arising most often from displaced otoconia in the posterior semicircular canal of the vestibular labyrinth. Treatment for BPPV is very specific and consists of placing the patient in a series of positions called a Canalith Repositioning Maneuver. BPPV is diagnosed through a procedure usually called a Dix-Hallpike maneuver in which the patient is moved into a position in which any free otoconia in a single posterior canal will be placed into the greatest degree of motion - causing the strongest response possible - while maintaining a neutral position of the opposite ear posterior canal and avoiding stimulation of that side. To assess the efficacy of the treatment, the Dix-Hallpike maneuver is repeated.

A similar condition can occur if otoconia are displaced within the anterior semi-circular canal. The anterior canal is positioned at a 90° orientation to the posterior canal and is therefore stimulated during the Dix-Hallpike maneuver. In this case, similar symptoms will occur, but the patient's vertigo and the torsional movement of the eyes will each be in the opposite direction. This can result in a false diagnosis of (posterior canal) BPPV if the clinician is not paying close attention. This creates a situation in which the canalith repositioning maneuvers relevant to a posterior canal dysfunction will have little or no effect. A further caution is that symptoms may fatigue during therapy because of dispersion of the otoconia, causing a false impression of improvement. There are maneuvers designed to assess the presence of an anterior canal positional vertigo and repositioning techniques specific to treating this condition.

Some treatments consist of repositioning techniques, such as the Sermon-Libératory maneuver, canalith repositioning techniques or other maneuvers.

In past years, the mention of a horizontal canal position vertigo was often followed with a question to ask if the possibility even existed. Horizontal canal involvement may occur and will result in a horizontal nystagmus - rather than torsional - which is ageotropic (beats away from the ground), geotropic, or changes direction. The most effective treatment for horizontal canalithiasis is to flex the neck to approximately 20 degrees and first turn the head to the involved side (~90

degrees), and wait until the nystagmus fatigues. The next step is to rotate the head to the uninvolved side again waiting for the nystagmus to fatigue. The patient is then asked to roll in the direction opposite from the involved side and onto their stomach. The patient next moves onto their involved side and then finally again on to their back. This procedure is similar to rolling a hot dog. The purpose of the procedure is to move the otoconia out of the horizontal canal.

Positional vertigo can also arise from neurological dysfunction. Although not nearly as common, most patients with these difficulties may not respond to medical treatment unless there is an underlying cerebrovascular origin to the patient's symptoms. Exercises to habituate the patient can be used to set a new normal, as described above, and overcome the symptoms.

Vestibulo-Ocular Reflex and VOR Therapy

The vestibulo-ocular reflex (VOR) is a compensatory response involving sub cortical pathways between the vestibular labyrinth and the cerebellum/oculomotor nerve. The VOR moves the eyes to an equal degree and in the opposite direction from the perceived head movement. The VOR functions primarily for high degrees of movement (> 2Hz, which is the upper threshold for the smooth pursuit system). In these situations, the compensatory motor control of the eyes is derived from sensory information of the vestibular labyrinth, rather than the visual system. One common complaint of patients with VOR deficits is that objects jump around when they are in motion. This is because they cannot stabilize their gaze while they are in motion.

Any disorder affecting the inner ear, vestibulocochlear nerve, certain areas of the brainstem, cerebellum, or oculomotor nerve may cause abnormal results when performing assessment of the VOR. Abnormal results can also occur without indications from any of these specific areas. These problems are typically described as just VOR deficits and are generally central in origin.

Therapy for those with VOR deficits include head rotation exercises, eye-head coordination exercises with and without averted gaze, and eye-head coordination exercises performed on a perturbing foam cushion to involve proprioception. Imaginary targeting exercises are also sometimes used to improve VOR function without visual dependence. These are exercises in which a patient looks at a target, then closes his eyes and moves his head. The patient should still be looking at the target when opening his or her eyes again.

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All these therapies essentially use the same principals as many of the other exercises discussed previously. They are essentially designed to strengthen the pathways that have been weakened through trauma, age, or a general lack of use.

Cervical-Related Conditions

Cervical conditions are often overlooked as a source of vestibular problems, but are likely more prevalent than most healthcare professionals believe. Any patient who exhibits a cervical restriction or cervical discomfort and experiences dizziness should be considered for treatment of that condition as part of the patient's ongoing care. Cervical problems can contribute to vestibular symptoms through both cerebrovascular restrictions and/or neurological inhibition. It has been my experience that there are a significant number of people with dizziness that have untreated cervical conditions as a cause. It is in the patient's best interest from a general health standpoint to address these issues and treatment may relieve symptoms of dizziness as well.

This is by no means a comprehensive list of vestibular and balance disorders and therapies. They are, however, the primary types of problems that patients with those problems will experience and the treatments and therapies typically used. Nearly all patients with vestibular and balance problems can benefit from referral to a therapist trained in vestibular therapies. We can not completely treat the underlying conditions for all of these patients, but by making the appropriate recommendations and referrals, we can improve the quality of life for many patients suffering from vestibular and balance problems.

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References:

¹Statistics from CDC web site: <http://www.cdc.gov/ncipc/factsheets/falls.htm>