

## Vestibular Rehabilitation Therapy (VRT)

For patients who have been referred for vestibular therapy.

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Page last modified: December 27, 2011

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### Introduction

This document discusses current ideas about therapy for dizziness and imbalance, also called "vestibular rehabilitation" (VRT), or more generally, "balance rehabilitation". Recent literature including double-blinded placebo controlled trials has generally supported the utility of vestibular rehabilitation in a variety of conditions associated with dizziness. Nevertheless, except for a few situations (i.e. BPPV treatment), these interventions are not "powerful" -- in other words, the effect of the intervention is generally significant but small.

We use the term "therapy" in a generic way -- these therapies are administered by physicians, physical therapists, occupational therapists, technicians, and audiologists. There are also some nearly "do-it-yourself" protocols that have been tested by time (e.g. [Cawthorne Cooksey](#))/ We think that a situation where there is an overseeing physician and a therapist, is optimal.

If you are looking for help in [finding someone to perform VRT, see this link](#). We strongly advise patients to steer clear of vestibular rehabilitation practices that lack physician oversight. Note that there are several new groups who are (in the author's opinion) practicing [vestibular rehabilitation fraud](#).

This review is unabashedly opinionated, based on 15 years of clinical experience of the author who is a specialist in the diagnosis and treatment of dizziness. The main message is that vestibular rehabilitation therapy is frequently worthwhile, but selection of the best type depends on both the diagnosis and health care situation. In the Chicago area, therapists in the author's practice ([Chicago Dizziness and Hearing](#)) are highly experienced in vestibular rehabilitation. We suggest avoiding "stand-alone" VRT without physician oversight.

### Indications for therapy

*There are many reasonable indications for vestibular rehabilitation:*

- Specific interventions for [BPPV](#) (Benign Paroxysmal Positional Vertigo). **These are very strong indications for PT.**
  - The Epley maneuver and the Semont maneuver ( see [BPPV page](#))
  - The Brandt-Daroff exercises (see [BPPV page](#) for details)
  - Log roll exercises (for [lateral canal BPPV](#))

- General interventions for vestibular loss
  - Unilateral loss, such as for [vestibular neuritis](#) or [acoustic neuroma](#) (Strupp et al. 1998; Herdman et al. 2003; Krebs et al. 2003; Badke et al. 2004; Cohen et al. 2004; Topuz et al. 2004; Hall et al, 2004; Enticott et al, 2005). [Follow this link for our suggested treatment protocol.](#)
  - Bilateral loss, such as for [gentamicin toxicity and related conditions](#). [Follow this link for our suggested treatment protocol.](#)
- Persons with fluctuating vestibular problems, not necessarily dizzy at the time of the therapy. The primary objective is to prepare the person for anticipated dizziness rather than to make any permanent change in their present vestibular situation.
  - [Meniere's syndrome](#) -- see also the specific page on [PT for Meniere's](#).
  - [Perilymphatic fistula](#)
- [Empirical treatment for situations where the diagnosis is unclear.](#)
  - [Post-traumatic vertigo](#)
  - [Multifactorial disequilibrium of the elderly](#)
- Psychogenic vertigo for desensitization
  - [Brandt-Daroff exercises](#) for phobic postural vertigo
  - Other situations where there is irrational fear of situations in which balance is challenged
- [Interventions for central vertigo.](#)

Individuals **not** likely to benefit from vestibular therapy include mainly persons without a vestibular problem, for example:

- [low blood pressure](#)
- medication reactions (other than ototoxicity)
- [Migraine associated vertigo](#) (although it has been reported to be helpful nonetheless, e.g. Whitney et al, 2000)
- [Transient ischemic attack -- TIA](#)

There are some conditions where it is not clear whether rehabilitation is helpful, but it seems likely at this writing that it is not helpful, or if beneficial, it might be a minor effect.

- [Mal de débarquement \(MDD\)](#)
- [Cerebellar degenerations](#)
- [Basal ganglia syndromes such as PSP](#) (There is inconclusive evidence that rehab helps in Parkinsonism, e.g. Keus et al, 2007)
- [Idiopathic motion intolerance](#) (except if psychogenic, see above)
  - Nevertheless, there are some promising approaches -- see [Puma method](#) )

Descriptions of the type of therapy applicable to each diagnosis can be found under pages that related to the condition itself.

### **Why might Vestibular Rehabilitation be useful ?**

Here we will consider the "generic" type of vestibular rehabilitation in which ataxic or vertiginous individuals are provided with a series of tasks to perform that require them to use their eyes while their head is moving, and possibly when their body is also moving. There are many processes that might be usefully influenced by experience and motion (see Hain, 2011 for more details):

- 1. Plasticity -- changes in central connections to compensate for peripheral disturbances. It would be nice if plasticity could handle everything. Unfortunately, there appear to be limits on how much the brain can compensate. Although conventional wisdom holds that older persons adapt less well than younger, a recent study suggests that there is no difference in benefit of vestibular rehabilitation according to age (Wriseley et al, 2002)
- 2. Formation of internal models -- a cognitive process where one learns what to expect from ones actions. Internal models are critical for [predictive motor control](#), which is essential when one is controlling systems that have delays. Much of the benefit of vestibular therapy may depend on internal models. An example of this is a recent study by Herdman et al (2007) showing recovery of better vision in persons with [bilateral vestibular loss](#) was attributed to "centrally programmed eye movements".
- 3. Learning of limits -- another cognitive process involved with learning what is safe and what is not. Someone who does not know their limits may be overly cautious and avoid dangerous situations. Someone who does not realize that, for example, they can't figure out which way is up, may drown in a swimming pool.
- 4. Sensory weighting -- a cognitive process in which one of several redundant senses is selected and favored over another. Classically, selection occurs between vision, vestibular and somatosensation inputs when one is attempting to balance. People with unreliable vestibular systems, such as those in Meniere's disease, sometimes seem to unable to switch off their visual reliance, causing them distress in certain situations where vision is an incorrect reflection of body movement (i.e. in the movies). (Lacour et al, 1997)

Vestibular therapy has been reported to cause no change in the risk of falling or the use of assistive devices (Brown, Whitney et al. 2001).

### **Who (if anyone) should oversee vestibular rehabilitation exercises ?**

Your options are:

1. Do it yourself (we realize that you may be planning this if you are reading this web page)
  1. Try to figure this out yourself (you might use the [Cawthorne Cooksey exercises](#) as a model)
  2. Take up an active sport suitable for balance training, such as
    1. Basketball, Tennis, Ping-pong, Volleyball
    2. [Tai Chi](#)
    3. Yoga
    4. [Nintendo-Wii](#)
2. Ask your doctor what to do (often not much better than #1)
3. Find a general occupational or physical therapist
4. Find a specialized vestibular rehabilitation therapist.
5. Go to a balance-rehabilitation practice (note that [fraud is common in this situation](#))

The "best" way of going about this is generally thought to be to find a specialized vestibular rehabilitation therapist. These are generally physical therapists, but there are also audiologists, occupational therapists, and physical trainers who do this sort of work. The [Vestibular Disorders Association \(VEDA\)](#) keeps a list of people who claim to be good at doing this (sort of a Yellow-pages for VRT).

There are several physical therapists in the Chicago area who have spent some time in our practice, and because we have observed them, we think they are good choices. A list of these physical therapists can be [found here](#).

Our advise is to find the most specialized person available and that you can afford or your insurance will cover, and see them as often as once/week, for about 2 months. If you can't make it every week, then just go less often and expect it may take longer to get results.

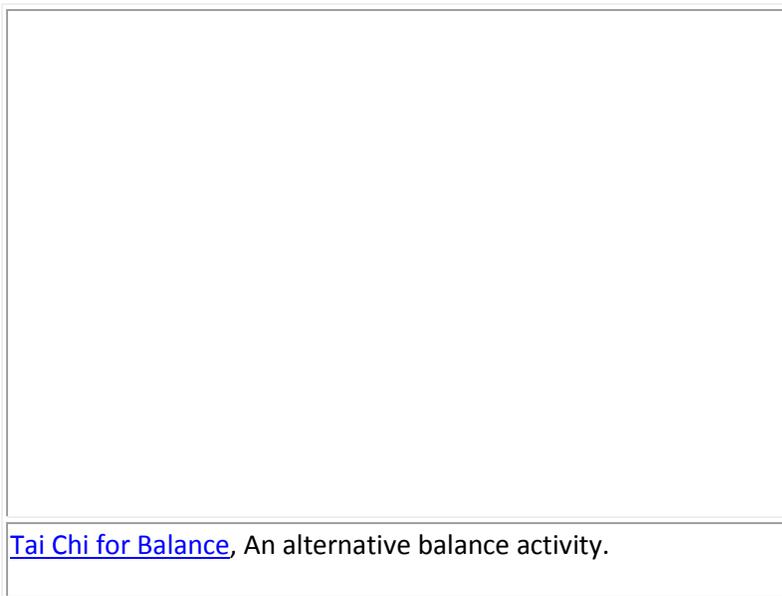
A quite good alternative to doing these somewhat boring exercises, supervised or not, is to take up an active sport. The sport should involve a lot of head movement and visual stimulation (such as basketball, dancing, volleyball). You probably won't be very good at this but it might be easier to motivate yourself.

## General Interventions:

One of the first "general" interventions for vestibular problems were the [Cawthorne-Cooksey exercises](#), (click on link for details). We will call these the "CC" exercises. These are a one page handout of activities that progress from simple head movement to complex activities such as throwing a ball. The major advantage of the Cawthorne-Cooksey exercises is that they are very low cost and often effective. (see extensive reference list at end). The main disadvantage the CC exercises is that they don't work for [BPPV, which is the most common type of dizziness](#).

When combined with an accurate diagnosis and use of [BPPV maneuvers](#) instead of these exercises, if appropriate, the CC approach is can be very effective. We also like the idea of having the patient see a therapist on an occasional basis to act as a "coach", as not all individuals are able to move though the exercises without help. Generalized physical therapy as well as computerized balance training has not been shown to prevent falls (Gillespie, Gillespie et al. 2001) .

Avocational activities can also be excellent for vestibular rehabilitation. In general, activities should involve using the eyes while the head and body are in motion. Of course, many avocational activities require this -- golf, bowling, tennis, racquetball, ping-pong, etc. The trick is to find one that is fun, safe, and somewhat stimulating. Just walking around the block looking from side to side may be a useful activity. Dancing is of course, an excellent vestibular rehabilitative activity. Martial arts activities are also beneficial, as long as physical injury is avoided.



"Alternative" balance activities. Yoga, [Tai Chi](#), and martial arts are the activities that have been considered in the literature. Tai Chi and Yoga both incorporate some relaxation which may be helpful for those who have anxiety accompanying their dizziness or imbalance. These activities are intrinsically lower in cost than individualized therapy, but their efficacy has not been compared in a head-on fashion to individualized therapy. They are probably most appropriate for those who have "graduated" from individual therapy.

The "[Wii-fit](#)" is a newer avocational activity that seems likely to be very good for VRT.

### **Individualized Vestibular Therapy**

In the 1990's an effort was begun, led by several academic physical therapists, to advocate exercises customized to individual diagnoses or at least functional patterns (e.g. Horak et al, 1992). Therapists performed an "evaluation", a physical examination, which allowed them to adjust their treatment program. For example, for [BPPV](#), in most cases it might seem irrational to treat with anything other than specific interventions such as the Epley maneuver (although general exercises seem to help a little too -- Fujino et al, 1994). This was an important development as prior to this time, therapists often used treated all dizzy patients with the same protocol (e.g.. the Cawthorne-Cooksey). The major advantage is greater efficiency. Reliable controlled studies showing that anything fancier than separating out the BPPV patients for special handling is significantly better than, for example, the Cawthorne-Cooksey exercises (see above) are presently hard to come by, although there have been some attempts (Smith-Wheelock et al, 1991). There is also evidence for a considerable positive effect of rehabilitation for chronic neurological disorders (Solari et al, 1999), suggesting that the general idea is worthwhile.

The disadvantage of individualized therapy is the higher cost compared to the [Cawthorne-Cooksey](#) or other "do it yourself" regimes. Usually four to eight sessions of therapy are prescribed (Gans, 1998), but sometimes as many as 16 sessions or ongoing treatment is recommended. This approach can be compared to working out with a personal trainer. The trainer is likely to be helpful, but the experience will cost you a bit more than doing it yourself.

### **The Evaluation in Vestibular Rehabilitation.**

Vestibular Rehabilitation therapists also often rely on a physical examination that uses a "foam and dome" to destabilize individuals, as well as more conventional devices such as [Frenzel goggles](#) (for diagnosis of [BPPV](#)).

The "foam" is a slab of spongy material that is makes it more difficult to balance as it gives way, reducing and delaying torques related to changes in the center of pressure. Persons who become more unstable on foam than age-matched norms are said to be more dependent on somatosensation -- sensation from

their ankles -- for stability than others. It might also select for persons who are less able to switch out of one mode of balancing (using somatosensation) into another. The result of the "foam" paradigm is difficult to interpret. The input -- perturbation to stance -- is an uncontrolled variable. A person who has very little postural shifts -- such as a person with early Parkinsonism -- might not sway at all on foam. A person who is fidgety, might sway more. The output is also difficult to calibrate. Whether or not a person takes a step might depend on their stability, their level of anxiety, etc. Whether or not use of the "foam" paradigm for evaluation is associated with better outcomes is presently unclear. It seems likely that using "foam" might be useful for persons with abnormally high somatosensory dependence (see below).

The "dome" is a lamp-shade like device that obscures vision without eliminating it (elimination of vision can obviously be done by closing the eyes, but in this situation people might switch off their visual processing). The logic of the dome is that it might select out persons who are visually dependent. Again, the input to this test is uncontrolled (postural sway), and the output is somewhat difficult to quantify. Whether or not use of the "dome" for evaluation results in better outcomes is presently unclear. Recently, other devices to destabilize vision have become available (e.g. DiscoBall). Again, whether or not this procedure results in better outcomes is presently unclear.

[Moving platform posturography](#) shares most of the same problems as the "foam and dome", but does have a better outcome measure (sway), as well as a better quantified input. When available, we think posturography is preferable to use of the "foam and dome".

The foam/dome examination reflects an attempt to separate out persons who are dependent on vision or somatosensory input for their stability. When vision or somatosensation becomes unreliable, it is thought that normally people switch over to a vestibularly driven balance strategy. Those that cannot

make this switch, are visually or somatosensory dependent. We think that this is a reasonable conjecture. We would, however, like to see some research studies documenting that it makes a difference to outcome or cost of treatment, if therapy is modified based on the "Foam and Dome" methodology, or for that matter, posturography.

### **Treatments that may be offered in Vestibular Rehabilitation**

We have listed various procedures that can be offered as part of vestibular rehabilitation. Excepting for treatment of BPPV, in general, the outcome of these procedures have not been studied to a great extent, and a recurring theme is that more research is needed.

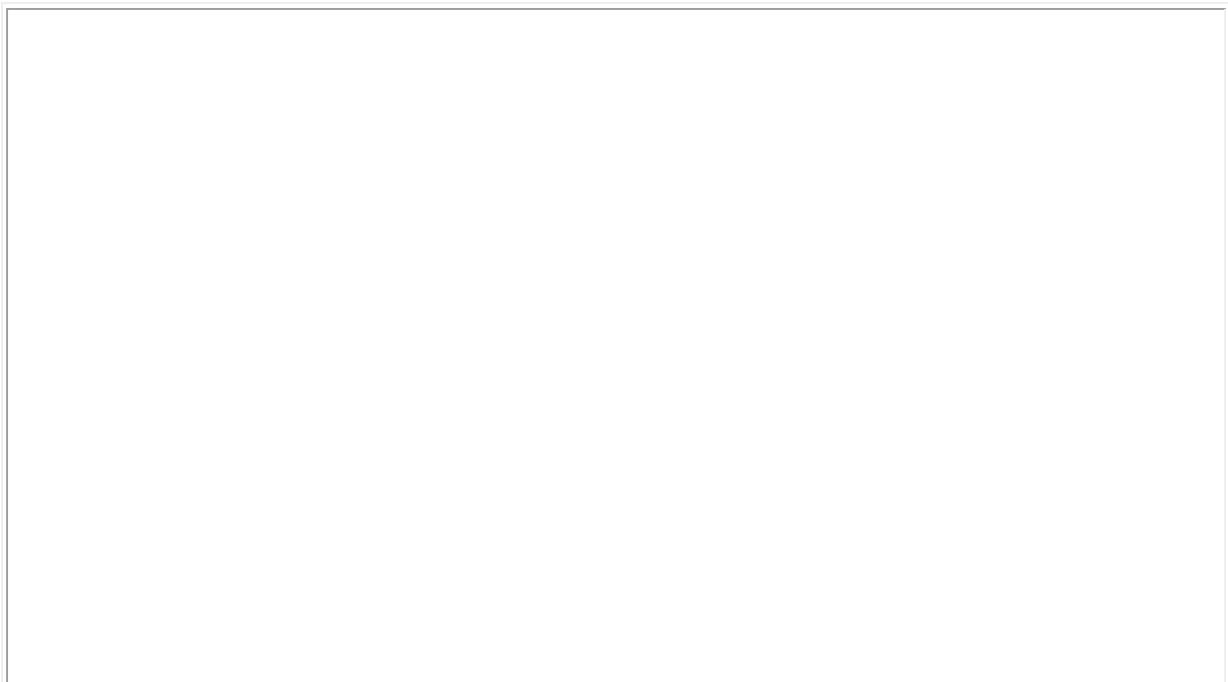
#### **[BPPV Treatment](#)**

Treatments for BPPV are dealt with in detail under the [BPPV page system](#). In our opinion, *BPPV should nearly always be treated with vestibular rehabilitation*, using specific maneuvers for the type of dizziness that patients experience.

#### **[Balancing Exercises](#)**

Follow the link above for much more detail. These exercises basically involve moving and balancing at the same time. One practices ones balance. Typical activities involve standing heel-toe, walking with the head moving back and forth, combining these activities with eyes closed, or on spongy surfaces. Activities such as walking, running, sports, Yoga or [Tai Chi](#) offer similar benefits (see above section on "general" interventions"). In our view, dynamic balancing exercises are appropriate for nearly all vestibular disorders.

#### **[Gaze Stabilization Exercises](#)**



Gaze stabilization exercises.

An illustration of the "Gaze Stabilization Exercises" is shown above. Follow this link for much more information about [Gaze Stabilization Exercises](#).

### [Visual Dependence Exercises](#)

It is not unusual for vestibular therapists to propose "interesting" treatments. For example, therapists might have patients smear their glasses with Vaseline. The rationale is to reduce "visual dependency", which is an inappropriate reliance on visual input, in situations where it might be better to use somatosensory or vestibular inputs. In certain situations, this seems like a good idea.

### [Physical conditioning Exercises](#)

One should not neglect physical conditioning. [See this page for suggestions](#).

### [Unusual Exercises:](#)

- Otolith recalibration
- Ocular tracking
- Axial Weight loading
- Virtual Reality
- Somatosensory dependence training
- habituation
- Deep breathing and proprioception exercises (Jauregul-Renaud et al, 2007).

Follow the link above for some more unusual protocols. These are not in general use.

### **Measuring response to Vestibular Rehabilitation Treatment**

We have put this section at the end as it is likely to be uninteresting to most. Measuring response is more difficult than it sounds. There are several difficulties:

- Tincture of time: Most disorders have a tendency to get better on their own, so one possible fallacy is to attribute improvement to therapy, without controlling for passage of time.
- What is important ? Most people limit their activities by their overall risk. As they feel more stable, they move around more. Measurement of falls or trips is related to activity times objective risk. Given that people want to increase their activity, they may keep their number of falls constant, as they improve. People with poor judgment will show simpler behavior.

- What is balance anyway ? There presently is no method of measuring "balance". There are numerous methods of measuring things that are associated with balance.
- How do you separate psychological aspects (i.e. fear of falling) from objective aspects (i.e. risk of falling) ?

Probably the most valid measure right now are subjective measures (i.e. [questionnaires](#)). An example of this is the DHI or dizziness handicap inventory and the activities-specific confidence scale (ABC). These measures can be used to capture subtle aspects of improvement such as increased independence (Cohen and Kimball,2003) . Other measure examples are listed [here](#). Nevertheless these measures are greatly handicapped by their intrinsic variability, and tendency for people to scale their responses according to what they think they should be doing, rather than actual performance.

Other measures of "balance" include [posturography](#), [rotatory chair testing](#), Active head rotation testing (VAT), [ENG testing](#), and mobility oriented scales such as the timed "get up and go" test, and the Berg balance scale.

#### References:

- Badke, M. B., et al. (2004). "Outcomes after rehabilitation for adults with balance dysfunction." Arch Phys Med Rehabil 85(2): 227-33.
- Brown KE, Whitney SL, Wrisley DM and Furman JM (2001). "Physical therapy outcomes for persons with bilateral vestibular loss." Laryngoscope 111(10): 1812-7.
- Clapton N and others. Effects of axial weight loading on gait for subjects with cerebellar ataxia: preliminary findings. Neurology Report 27, 1, 2003, 15-21
- Cowand JL and others. Efficacy of vestibular rehabilitation. Otolaryngology Head&Neck surgery 118(1)49-54, 1998
- Cohen HS, Kimball KT Increased independence and decreased vertigo after vestibular rehabilitation. Otolaryngol Head Neck Surg 2003 Jan;128(1):60-70
- Dix MR, and Hood JD (ed). Vertigo. Wiley and Sons, Chinchester, 1984
- Enticott, J. C., J. O'Leary S, et al. (2005). "Effects of vestibulo-ocular reflex exercises on vestibular compensation after vestibular schwannoma surgery." Otol Neurotol26(2): 265-9.
- Fujino A and others. Vestibular training for benign paroxysmal positional vertigo. Arch Otolaryngol HNS 1994:120:497-504.
- Geiger RA, Allen JB, O'Keefe J, Hicks RR. Balance and mobility following stroke: Effect of physical therapy interventions with and without biofeedback/forceplate training. Physical Therapy 81:4, 2001, 995-1005
- Ganz RE. A question of balance. Hearing Health, May/June 1998, vol 14, #3, 38-42

- Gillespie LD, Gillespie WJ, Robertson MC, Lamb SE, Cumming RG and Rowe BH (2001). "Interventions for preventing falls in elderly people." Cochrane Database Syst Rev(3): CD000340.
- Hain, T. C. (2011). "Neurophysiology of vestibular rehabilitation." NeuroRehabilitation 29(2): 127-141.
- Hall CD, Schubert MC, Herdman SJ. Prediction of fall risk reduction as measured by dynamic gait index in individuals with unilateral vestibular hypofunction. Otolology and Neurotology, 25: 746-751, 2004
- Herdman SJ (ed). [Vestibular Rehabilitation \(Contemporary...](#) . F.A. Davis Co, Philadelphia, 2000
- Herdman, S. J., et al. (2003). "Recovery of dynamic visual acuity in unilateral vestibular hypofunction." Arch Otolaryngol Head Neck Surg 129(8): 819-24.
- Herdman SJ, Hall CD, Schubert MC, Das VE, Tusa RJ. Recovery of dynamic visual acuity in bilateral vestibular hypofunction. Arch Otolaryngol HNS 2007;133:383-389
- Horak FB et al. Effects of vestibular rehabilitation on dizziness and imbalance. Otol HNS 1992:106-175
- Jacob RG, Whitney SL, Detweilder A, Shostak G, Furman JM. Vestibular rehabilitation for patients with agoraphobia and vestibular dysfunction: A pilot study. Anxiety Disorders 15(2001) 131-146
- Jauregul-Renaud K, and others. JVR 2007:17:63-72
- Keus S, and others. Evidence-based analysis of physical therapy in Parkinson's disease with recommendations for practice and research. Movement Disorders, 23, 4, 2007, 451-460
- Krebs, D.E., et al., Double-blind, placebo-controlled trial of rehabilitation for bilateral vestibular hypofunction: preliminary report. Otolaryngol Head Neck Surg, 1993. 109(4): p. 735-41.
- Krebs, D. E., et al. (2003). "Vestibular rehabilitation: useful but not universally so." Otolaryngol Head Neck Surg 128(2): 240-50.
- Lacour M, and others. sensory strategies in human postural control before and after unilateral vestibular neurotomy. Experimental Brain Research (2) 300-10, 1997.
- McDermott KH, Matheson AJ, Titov N, Darlington CL and Smith PF (1999). "Does habitual, vigorous optokinetic stimulation alter optokinetic nystagmus and sensitivity to circularvection?" J Vestib Res 9(1): 59-61.
- Smith-Wheelock et al: American J. Otol, May 1991, 218-25
- Solari and others. Physical rehabilitation has a positive effect on disability in multiple sclerosis. Neurology 1999;2:57-62

- Strupp, M., et al. (1998). "Vestibular exercises improve central vestibulospinal compensation after vestibular neuritis." *Neurology* 51(3): 838-44.
- Tee LH, Chee NWC. Vestibular rehabilitation for the Dizzy Patient. *Ann Acad Med Singapore* 2005;34:289-94
- Telian SA, Shepard NT. Update on vestibular rehabilitation therapy. *Oto Clin NA*, 29:357-71, 1996
- Topuz, O., et al. (2004). "Efficacy of vestibular rehabilitation on chronic unilateral vestibular dysfunction." *Clin Rehabil* 18(1): 76-83.
- Viire E, Sitarz R. Vestibular rehabilitation using visual displays: preliminary study. *Laryngoscope* 2002;112(3) 500-3
- Walker C, Brouwer B, Culhan EG. Use of visual feedback in retraining balance following acute stroke. *Physical Therapy*, 80, 9, 2000
- Whitney, S.L., et al., Physical therapy for migraine-related vestibulopathy and vestibular dysfunction with history of migraine. *Laryngoscope*, 2000. 110(9): p. 1528-34.
- Whitney SL, Wrisley DM, Marchetti GF, Furman JM. The effect of age on vestibular rehabilitation outcomes. *Laryngoscope* 2002 Oct;112(10):1785-90

#### **References specific to Cawthorne Cooksey exercises (a home protocol)**

- Aranda, C., A. Meza, et al. (2009). "Diabetic polyneuropathy may increase the handicap related to vestibular disease." *Arch Med Res* **40**(3): 180-5.
- Bamiou, D. E., R. A. Davies, et al. (2000). "Symptoms, disability and handicap in unilateral peripheral vestibular disorders. Effects of early presentation and initiation of balance exercises." *Scand Audio* **29**(4): 238-44.
- Belal, A., Jr. and A. Glorig (1986). "Dysequilibrium of ageing (presbyastasis)." *J Laryngol Otol* **100**(9): 1037-41.
- Bittar, R. S., M. E. Pedalini, et al. (2002). "Treating vertigo with vestibular rehabilitation: results in 155 patients." *Rev Laryngol Otol Rhinol (Bord)* **123**(1): 61-5.
- Corna, S., A. Nardone, et al. (2003). "Comparison of Cawthorne-Cooksey exercises and sinusoidal support surface translations to improve balance in patients with unilateral vestibular deficit." *Arch Phys Med Rehabil* **84**(8): 1173-84.
- Cawthorne, T: The Physiological Basis for Head Exercises. *The Journal of The Chartered Society of Physiotherapy* 30:106, 1944.
- [Cawthorne T. Vestibular injuries.](#) *Proc R Soc Med* 1946;39:270-272.

- [Cooksey FS. Rehabilitation in vestibular injuries.](#) *Proc R Soc Med* 1946;39:273-275
- Dix, M. R. (1979). "The rationale and technique of head exercises in the treatment of vertigo." *Acta Otorhinolaryngol Belg* **33**(3): 370-84.
- Hamann, K. F. (1993). "[Therapy of vestibular vertigo]." *Hno* **41**(5): 278-85.
- Hecker, H. C., C. O. Haug, et al. (1974). "Treatment of the vertiginous patient using Cawthorne's vestibular exercises." *Laryngoscope* **84**(11): 2065-72.
- Jauregui-Renaud, K., L. A. Villanueva Padron, et al. (2007). "The effect of vestibular rehabilitation supplemented by training of the breathing rhythm or proprioception exercises, in patients with chronic peripheral vestibular disease." *J Vestib Res* **17**(1): 63-72.
- Kulcu, D. G., B. Yanik, et al. (2008). "Efficacy of a home-based exercise program on benign paroxysmal positional vertigo compared with betahistine." *J Otolaryngol Head Neck Surg* **37**(3): 373-9.
- Mantello, E. B., J. C. Moriguti, et al. (2008). "Vestibular rehabilitation's effect over the quality of life of geriatric patients with labyrinth disease." *Braz J Otorhinolaryngol* **74**(2): 172-80.
- Pavan, K., B. E. Marangoni, et al. (2007). "[Vestibular rehabilitation in patients with relapsing-remitting multiple sclerosis]." *Arq Neuropsiquiatr* **65**(2A): 332-5.
- Ribeiro Ados, S. and J. S. Pereira (2005). "Balance improvement and reduction of likelihood of falls in older women after Cawthorne and Cooksey exercises." *Braz J Otorhinolaryngol* **71**(1): 38-46.
- Szturm, T., D. J. Ireland, et al. (1994). "Comparison of different exercise programs in the rehabilitation of patients with chronic peripheral vestibular dysfunction." *J Vestib Res* **4**(6): 461-79.
- Tokumasu, K., A. Fujino, et al. (1993). "Prolonged dysequilibrium in three cases with vestibular neuronitis: efficacy of vestibular rehabilitation." *Acta Otolaryngol Suppl* **503**: 39-46.
- Topuz, O., B. Topuz, et al. (2004). "Efficacy of vestibular rehabilitation on chronic unilateral vestibular dysfunction." *Clin Rehabil* **18**(1): 76-83.
- Zanardini, F. H., B. S. Zeigelboim, et al. (2007). "[Vestibular rehabilitation in elderly patients with dizziness]." *Pro Fono* **19**(2): 177-84.
- Zeigelboim, B. S., K. F. Klagenberg, et al. (2009). "Vestibular rehabilitation: clinical benefits to patients with Parkinson's disease." *Arq Neuropsiquiatr* **67**(2A): 219-23.

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