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Balance and Vestibular Rehabilitation Therapy

This document discusses current ideas about physical therapy for dizziness and imbalance, also called "vestibular rehabilitation", or more generally, "balance rehabilitation". While there is some data regarding the efficacy vestibular rehabilitation (e.g. Cowand et al, 1998), much remains to be done. Also, herein we use the term "physical therapy" in a generic way -- many of these therapies are administered by persons other than physical therapists -- including physicians, occupational therapists, and audiologists.

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. This page is primarily intended to be a reference for patients who have been referred for therapy.

Indications for therapy

There are five reasonable indications for vestibular rehabilitation:

1. Meniere's syndrome
2. Perilymphatic fistula
3. Empirical treatment for situations where the diagnosis is unclear.
4. Post-traumatic vertigo
5. Multifactorial disequilibrium of the elderly

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 debarquement (MDD)
- Cerebellar degenerations
- Basal ganglia syndromes such as PSP (There is some evidence that rehab helps in Parkinsonism)
- Idiopathic motion intolerance (except if psychogenic, see above)

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:

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.

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)

General Interventions:

One of the first "general" interventions for vestibular problems were the Cawthorne-Cooksey exercises, (click on link for details). 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. When combined with an accurate diagnosis and use of BPPV maneuvers instead of these exercises, if appropriate, this approach is can be very effective. We also like the idea of having the patient see a physical therapist on an occasional basis to act as a "coach", as not all individuals are able to move though the exercises without help.

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.

"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 that 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 physical therapy.

Individualized Physical 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", or in other words, 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 physical 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 is associated with better outcomes is presently unclear.

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.

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 if therapy is modified based on the "Foam and Dome" methodology, or for that matter, posturography.

Treatments that may be offered in Vestibular Rehabilitation

As an overview, 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.
Treatments for BPPV are dealt with in detail under the BPPV pages.

Gaze Stabilization Exercises

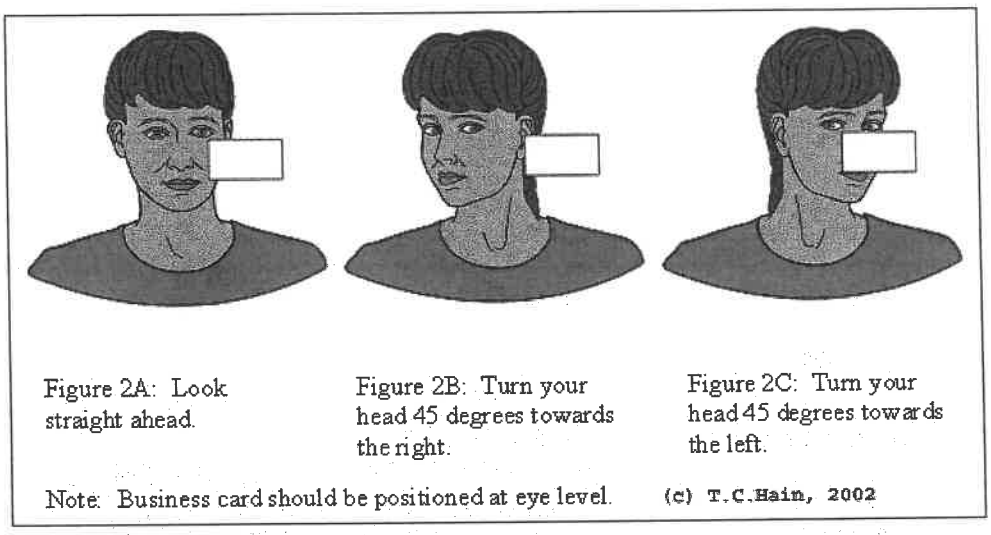

Figure 2A: Look straight ahead.

Figure 2B: Turn your head 45 degrees towards the right.

Figure 2C: Turn your head 45 degrees towards the left.

Note: Business card should be positioned at eye level. (c) T.C.Hain, 2002

An illustration of the "Gaze Stabilization Exercises" is shown above.

This is an exercise especially apropriate for persons with bilateral vestibular loss(Krebs, 1991) as well as being a reasonable procedure for persons with unilateral vestibular disturbances such as vestibular neuritis or persons who have had tumors of the 8th nerve removed. This exercise should be "progressed" to a more difficult one as it is mastered. We have only shown a part of the exercises here.

Visual Dependence Exercises

It is not unusual for vestibular therapists to propose other treatment maneuvers. 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. Does smearing vaseline on glasses reduce visual dependency ? Nobody knows. If we had a reliable method of measuring visual dependence, perhaps we could relate it to interventions. At this writing, posturography seems to be the closest to being a measure of visual dependency. Virtual reality training might offer a better method of reducing visual dependency. This promising technology is in it's infancy right now, and research studies are needed to validate it.

Somatosensory Dependence Exercises

Following the same train of thought as the visual dependency exercises, perhaps it might be of benefit for someone to practice maintaining their balance in situations where somatosensory (ankle and pressure) input is either reliable or just not there. Somatosensory input can be distorted using tilt-boards, rails, slabs of foam, or just by walking on the beach. Forcing someone to do this might encourage them to recalibrate and rely to a greater extent on their vestibular or visual sensory inputs. Is this a good idea ? Based on experience, it probably is -- more studies are needed though.

Otolithic Recalibration Exercises

Bouncing on Swiss balls or mini-tramps may be advocated to build up the otolith-ocular reflex as well as otolith-postural reflexes. Again, this might be a good idea, but we are presently lacking any reasonable way to measure the otolith-ocular reflex and also we have little idea as to it's significance in daily life. There are essentially no situations in which otolith function is selectively elimianted in humans. Thus, there are no "experiments of nature" with which one might decide whether this protocol is useful. It would be interesting to see if this procedure is associated with improved outcome, as compared to another activity (such as perhaps weight-lifting).

Ocular Tracking Exercises

Patients may be urged to track objects that are moving in counterphase to their heads, generally moved by themselves. This procedure might encourage patients to use both visual tracking and vestibular stabilization in tandem. There is no natural situation that this exercise might help them with. Similarly,

patients may be asked to track objects that are moving with their heads. This procedure might encourage patients to turn off their vestibular system. This might, in theory, be useful for persons with vestibular imbalance such as those with Meniere's disease. It would be unlikely to be helpful in persons who already have their vestibular system turned off (i.e. persons with bilateral vestibular loss).

Posturography Training

Training devices are often found in physical therapy settings. These include devices made by Neurocom (for example, the Smart Balance-Master),Metitur, Micromedical Technology, and KAT.

Little outcome information is available about posturography training. These procedures involve a moving platform coupled to a computer monitor. The patient is asked to keep their center of pressure within a box on the screen or to track a visual target by shifting their weight on the platform. Typically two sessions are given per week over several weeks. In our opinion, this procedure seems unlikely to promote neuroplasticity or adaptation (because it is too short), but it might assist individuals in forming internal models of their body and the outside world. Forming and recalibrating internal models is certainly a worthwhile endeavor, critical to recovery from lesions. It seems likely to occur in time whether or not a device like this is available, but the progress of revising an internal model might be accelerated through guided practice.

Regarding data, two recent studies suggested that there is no benefit from the Smart Balance-master training paradigm over conventional PT for acute stroke balance rehabilitation (Walker et al, 2000; Geiger et al, 2001). In our opinion, these studies are flawed because in this situation, it would seem to us that the effects of the training might be obscured by natural time dependent neural processes involved in stroke recovery that would progress with or without a daily 30 minute exposure to a training device. Also, study of strokes seems to us a poor choice of model, as it is very difficult to find a large number of people with stroke who have exactly the same size, and location of their neurological lesion.

Nevertheless, as noted above, there are some theoretical reasons to suspect that such devices might be helpful in accelerating the pace of recovery even though the exposure time is short. Additional studies are needed to determine the utility of these devices in other contexts than acute stroke such as vestibular imbalance or loss. One interesting question would be to see whether these devices have utility in more static clinical situations (such as a person who has had imbalance for several years). Another would be to examine the utility of these devices in contexts where the lesion perturbing balance is well understood, standardized and acute.

Virtual Realty Training

Virtual reality seems like a particularly promising method of treating people with inappropriate visual dependence. It seems a lot more likely to work than smearing vasoline on ones glasses (see above). Perons with visual dependence are the people who get sick from looking at ceiling fans, or going to the Omnimax. Virtual reality is new, and at present, there are few studies that bear on this intervention. There has been some preliminary work done by Viirre, suggesting that virtual reality may help assist in increasing abnormally low vestibular ocular reflex gain (Virre and Sitarz, 2002)

Measuring response to Vestibular Rehabitation 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 physical 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.

Probably the most valid measure right now is subjective measures (i.e. questionnaires). An example of this is the DHI or dizziness handicap inventory and the activities-specific confidence scale (ABC). Other 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, ENG testing, and mobility oriented scales such as the timed "get up and go" test, and the Berg balance scale.

Other pages related to vestibular rehabilitation

Mayo Clinic Vestibular Rehab

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