

Why Vestibular Rehab Works – Part Three

You may find it interesting to know that the use of exercises in treating vestibular conditions, is a relatively old method dating back to the 1940's and was mostly based on experiences of patients who were trying to recover from them.

It was not until the 1990's that we began to understand the what, how and why of exercises that shape how we rehabilitate from vestibular conditions today, and much credit goes to Ms Susan Herdman, physical therapist, researcher and professor for her immense contribution to this area.

Broadly speaking, the two main categories of conditions that seem to respond best to vestibular rehabilitation are 1) unilateral vestibular loss or paresis and 2) benign paroxysmal positional vertigo (BPPV).

Unilateral, or one sided, vestibular paresis refers to a loss of accuracy in processing sensory information anywhere along the vestibular system that is pathological in nature on one side. This means that there is change in the architecture of the system, such as hair cell loss, inflammation of the nerves, swelling in the cochlea or infection.

Examples include:

- vestibular neuritis
- acoustic neuroma
- Meniere's disease
- large vestibular aqueduct syndrome
- superior semicircular canal dehiscence
- Ramsay Hunt syndrome

With a loss of vestibular activity on the affected side and normal activity on

the other side, you get an imbalanced signal to the brain, which results in symptoms of dizziness, illusion of movement (true vertigo) and loss of balance if vision is removed.

Treatment for unilateral vestibular loss may require medications such as steroids, diet control, surgery and just time. Once the initial period of treatment has commenced, vestibular rehabilitation can begin.

BPPV

In contrast, BPPV is a mechanical problem local to the inner ear apparatus. It is called benign paroxysmal positional vertigo because it is completely triggered by position and movement, and physiotherapy can help diagnose and treat the condition directly in 1-3 sessions normally.

Going back to our first post in this series, you may remember that there are 5 sensory organs to the vestibular system. The 3 semicircular canals and the otoliths organs – the utricle and saccule. In this system there are crystals made of calcium carbonate (otoconia) that cover the hair cells in the utricle and saccule. In BPPV, these crystals can sometimes find themselves lodged in other areas or dislodged into one of the semicircular canals. This usually occurs on one side in most people.

This means we have a foreign body either suspended in fluid in the inner ear, or stuck someplace else and creating unnecessary stimulation. This tricks the brain into thinking that we are moving and adjusts the eyes accordingly. This causes the eyes to beat in unison in predictable patterns, and this is known as nystagmus. Knowing which way the eyes are beating and how long they beat for tells us where the problem lies.

To treat the problem, we must decide whether the crystals need to be repositioned or dislodged. This dictates the series of rolls, turns and positions our head must go through to restore their position. Once restored, vestibular rehabilitation can commence.

So what is vestibular rehabilitation?

Vestibular rehabilitation is a specialised form of rehabilitation that helps people overcome the dizziness and vertigo-like symptoms that affect function. It adopts habituation, adaptation and substitution theories to gradually reduce symptoms.

Habituation

Over time, the brain partly compensates for unilateral vestibular problems by starting to ignore abnormal signals imbalances. You can imagine this to be like driving a car with a flat tyre on the left, and the driver turning the steering wheel to the right to ensure it stays in the middle of the road. This form of compensation is called habituation because the brain makes it a habit to take the signal imbalance in its stride.

Habituation works by repeatedly exposing the person to a stimulus that brings on symptoms, with the idea that doing so will reduce its symptoms. For example, if the body experiences dizziness when the head moves up and down, a possible starting point may be to nodding and gradually building up to larger arcs of movement until it no longer becomes aggravating. Over time, habituation builds into the body's neurological circuits in the form of neuroplasticity. This method works best if movement is the main trigger, but you can argue that it may work for other triggers such as light, sound and large spaces provided the stimulus can be graded.

The vestibular ocular reflex

Have you ever wondered why you can still see your hand clearly even if your head is moving quickly in circles?

But then when you keep your head still and then move your hand quickly, it looks blurry?

This is what our ocular reflexes do. In the first case, we use the vestibular ocular reflex (VOR) to keep the image clear because the information from our inner ear quickly tells our eyes where to look. This is called gaze stability and it is a reflex that happens without conscious thought. The VOR is very important for balance and daily tasks because they happen so quickly, and is often compromised in unilateral vestibular loss type conditions.

You can improve your VOR with a common exercise at home:

1. Find a book with a title and hold it out in front of you and focus on one letter.
2. Keep your eyes on the letter and turn your head sideways as quickly as possible, keeping your eyes on the letter, so long as it stays in focus.
3. Repeat this for 1 minute.

You can also make this more difficult by moving the book in the opposite direction to your head, or by varying the distance between the eye and the object.

Substitution

In the second case, the reason why the hand is blurry when we move it quickly is because the head is still and therefore there is no new information on the vestibular system and hence the brain cannot use the VOR. Instead, it must rely on the speed of ocular muscles to fire in response to the moving target. This system is less sensitive and accurate at high speeds, but it can partially substitute when the VOR is not working as well. This is called substitution and can be trained with practise to anticipate movement, but it will never fully compensate for the VOR.

We can also substitute the loss of balance information from the vestibular system with more information from the body's other senses. This can be visual scanning with head movement, which uses the cervico-ocular reflex (COR). This reflex links the eyes to the head and neck position but does not seem to work as quickly as the VOR, and hence we cannot expect full

substitution.

Adaptation and Maladaptation

As mentioned earlier, the brain can make sense of a bad situation and compensate for it through habituation. It can also learn to adapt to the situation by fixing gaze or visual fixation. People do this when they are dizzy or experience vertigo to stop their eyes from beating and regain some balance. While this helps reduce symptoms in the short term, I consider it mal-adaptive because this is not practical most of the time in day to day function. It is also incredibly tiring.

A more effective way of going about it is to reduce visual fixation and where possible, retrain the vestibular system through a series of activities. This can be done by getting people to wear glasses with petroleum jelly smeared on them and perform balance or turning tasks, and I know that sounds cruel but it means that you get a better functioning vestibular system which is much more useful in the long run.

What else goes with vestibular rehabilitation?

Restoring neck muscle function, tone and control are important areas to consider in total rehabilitation. This is because the neck is a rich source of information to the brain, balance and vestibular systems and even discomfort or altered postures can send mixed messages that make recovery more difficult or longer.

Giving patients some control of their rehabilitation in the form of home exercises is a great way to keep symptoms at bay. It needs to be done fairly frequently (3-5 times a day) and gradually so we can create the ideal environment for habituation, substitution and neuroplasticity to occur.

Besides the physical aspect, any psychological and social factors associated with vestibular conditions should also be addressed. People with a

chronic vestibular problem often report a loss of confidence and low mood, which affects their ability to engage in brighter, louder and more stimulating environments, and can be the difference between making a full recovery and a partial one.

Depending on complexity, psychologists, occupational therapists, audiologists and ENT specialists and otoneurologists may need to be involved to develop a holistic, individualised and effective program of vestibular rehabilitation to address all the triggers, treat the causes and find the right solutions so people can lead a normal life again.

While this form of face to face intervention is the traditional model of care, telehealth is emerging in most research circles and vestibular rehabilitation is no exception. Gerarghty et al (2014) is looking into the feasibility of an internet-based vestibular rehabilitation in adults and it will be interesting to see his results. This is no doubt an exciting step for the future as we transcend geography and access points to care. My, how far we have come from the 1940's.

Resources:

Gerarghty, A., Kirby, S., Essery, R., Little, P., Bronstein, A., Turner, D., Stuart, B., Andersson, G., Carlbring, P. and Yardley, L. (2014) Internet-based vestibular rehabilitation for adults aged 50 years and over: a protocol for a randomised controlled trial. *British Medical Journal* 4 (7).

Herdman, S. (1997) Advances in the Treatment of Vestibular Disorders. *Physical Therapy*, 77 (6), pp 602-618

Lechner, C., Taylor, R., Todd, C., MacDougall, H., Yavor, R., Halmagyi, M. and Welgampola, M. (2014) Causes and characteristics of horizontal positional nystagmus. *Journal of Neurology*, 261, pp 1009-1017