



## LET'S TALK ABOUT . . .

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# BALANCE AND DIZZINESS: DIAGNOSTIC TESTS

Based on your history and physical findings, your doctor may request other tests including a CT (**computerized tomography**) scan, MRI (**magnetic resonance imaging**) scan or **ultrasound** and ECG (**electrocardiogram**) as well as **blood** and **neurological tests** to rule out a more serious or life-threatening condition. You may also have some of the following tests to see how well different parts of your balance system are functioning:

## Hearing tests

Not all **vestibular disorders** affect the hearing portion of the ear. However, some may affect hearing and balance at the same time. For this reason, patients with complaints of dizziness or imbalance often have detailed hearing tests. These include:

- pressure test to check eardrum movement
- testing how the hearing system reacts to loud noises
- checking for small echoes coming from the inner ear in response to a sound

The resulting test patterns can potentially reveal problems with the balance system. A normal hearing test is in itself informative.

## Balance tests

The **GANS Sensory Organizational Performance (SOP) test** and **Computerized Dynamic Posturography (CDP)** are different ways of assessing overall patterns of balance performance under different conditions.

Some **diagnostic centres** use the GANS SOP test and others use CDP.

Although no test of balance performance can provide a specific diagnosis, there are patterns of results that can be correlated with other vestibular tests and may indicate different types of **balance disorders**.

## Vestibular function tests

Clinical tests of vestibular function assess whether there are problems with the balance structures of the inner ear (vestibular system) and/or their connections with our eyes, central nervous system and the proprioceptive system (sense of self movement and body position). These complex structures sit beside the hearing structure (the cochlea) of the inner ear.

The **balance system** consists of 5 sensors in each ear - 3 fluid-filled semicircular canals and 2 otoliths (utricle and saccule). There are tests to assess all 10 of these sensors.

## How can I get tested for vestibular function?

Family practitioners, vestibular therapists and some audiologists routinely perform the **Dix-Hallpike and/or roll tests** for **benign paroxysmal positional vertigo (BPPV)** – these are positional tests that figure out whether your dizziness is triggered or made worse by certain head movements. Some of these practitioners put specialized goggles on the patient to get a more precise look at eye movements and better determine which ear canal is affected. Using the goggles, they are able to detect involuntary, rapid movements of the eyes (nystagmus).

More comprehensive vestibular function testing is offered at several locations in British Columbia. A referral from a specialist is required to book an appointment. View our guide to **diagnostic services** for the locations of testing centres in BC. A full assessment of the vestibular system can take up to 3 or 4 hours and may be done over several appointments.

## Will the tests make me dizzy?

The majority of the diagnostic tests cause little or no dizziness. One portion, however, induces temporary dizziness and sometimes nausea.

## What if all the tests results are normal?

There is nothing wrong with all of the tests being normal; do not fight normal results. Normal results are very helpful and do not mean that the doctor will not believe something is wrong. Although new tests can reveal how your balance system is able to reference gravity, current testing is not sensitive enough to pick up some problems coming from some parts of the balance system. A normal set of tests does not rule out a problem.

## Vestibular tests that involve muscles

There are pathways that go from the otoliths (utricle and saccule) in the inner ear to different muscle sets. These pathways stimulate responses that can be measured on the muscles.

Currently, two types of muscle tests can be done to assess the utricle and saccule:

- **cVEMP (Cervical Vestibular Evoked Myogenic Potential) test**

The cVEMP test uses the muscles in the neck to record a response from one of the balance system structures called the saccule. Sensors are attached to the forehead, collarbone and on either side of the neck. Loud sounds played through earphones activate the saccule as the patient contracts the neck muscle on one side, then the other.

A properly functioning saccule will evoke a response. No response on one side or on both sides is abnormal; an asymmetrical response (one side significantly different from the other) also suggests that there is something wrong. One other part of the cVEMP test lowers the sound volume to a level where there should not be a response (it should disappear due to the thickness of the skull protecting the saccule). However, if there is a temporal bone dehiscence (thinning of the bone) these lower volume sounds will evoke a response – this is abnormal.

cVEMP testing can take anywhere from 30 to 60 minutes in most centres. Occasionally it can cause a slight sensation of brief dizziness.

- **oVEMP (Ocular Vestibular Evoked Myogenic Potential) test**

The oVEMP test engages a little eye muscle around and under each eye. Sensors are attached to the collarbone, sides of the nose and under each eye. At some testing centres a sound is played in the ear. In other centres a device called “mini-shaker” is used to activate the utricle by strongly tapping the forehead. The response on both sides is again measured. No response on one or both sides, or an asymmetrical response, indicates a problem with the utricle.

The oVEMP test can also help detect a **temporal bone dehiscence**.

The test takes about 30 to 60 minutes. Most people do not get dizzy or nauseous with this test.

## vHIT (Video Head Impulse Test)

One of the jobs of the balance system is to stabilize the eyes; the vestibular-ocular reflex (VOR) allows us to keep our gaze stable while moving our head. The vHIT assesses how the VOR is functioning. Another name for this diagnostic tool is the **HIMP (Head IMPulse) test**.

Patients put on special goggles that record eye movements when the head is moved quickly. People with neck problems may not be able to do all or parts of this test. The vHIT test assesses all six semicircular canals. Most people do not get dizzy or nauseous with this test.

## SHIMP (Suppression Head IMPulse) test

Used along with vHIT, this tests helps figure out the extent of vestibular function. It lessens the need for ice water testing when such caloric testing is called for.

## VNG (Videonystagmography)tests

VNG tests involve wearing goggles fitted with infrared cameras that record eye movements. VNG tests may reveal nystagmus, an abnormal involuntary repetitive “jumping” movement of the eyes - this may be an indicator of vestibular malfunction.

There are three main types of tests done with VNG goggles:

- **Oculomotor tests**

Oculomotor tests assess the brain's ability to make and control voluntary eye movements. Abnormal results can indicate problems in the brain stem and/or cerebellum. Most people do not get dizzy or nauseous with these tests.

- **Positioning and positional VNG tests**

These tests assess the six semicircular canals, as well as look for possible problems in the central nervous system. They are done in a variety of positions, including those that are known to bring on vertigo for a patient. Positioning VNG tests are helpful in detecting a fairly common disorder known as benign paroxysmal positional vertigo (BPPV). If a patient has BPPV, the test can cause a brief episode of dizziness; this can be very helpful in diagnosing this disorder.

- **Caloric test**

Also known as the "water test," this vestibular function test assesses the lateral (horizontal) semicircular canals and corresponding nerve pathways. The left and the right ear are tested one at a time by putting warm or cool water in the ear for 30 seconds while the patient wears the VNG goggles. Some pressure may be felt in the ear canal. The temperature of the water transfers to one of the semicircular canals and warms it up or cools it down, which briefly changes the fluid density in the vestibular system. This temporarily tricks the vestibular system and often induces brief dizziness.

The caloric test is done at least once in each ear with warm water in some centres. Often one warm and one cool irrigation is done in each ear. Very rarely ice water is used to determine if there is any function at all left in that part of the vestibular system.

It is very helpful both for the patient and also for the assessing clinician to compare the dizziness caused by the water test with the dizziness that the patient is suffering from.

### **Dynamic visual acuity (DVA) test**

A primary function of the vestibular system is to maintain the stability of your eyes while your head is in motion. The DVA (ability to see clearly while moving) test measures gaze stabilization with the head moving versus stationary.

This useful test is routinely done to help measure change in the vestibular ocular reflex (VOR) after vestibular rehabilitation. It shows if your brain has been able to compensate for a vestibular problem. During this test you will be asked to view the letter "E" and determine its orientation. The test is then repeated with head movement. The DVA test is routinely done during vestibular rehabilitation.

## Functional vision tests

A regular eye exam takes about 20 to 30 minutes to determine if you need a pair of glasses. The extensive testing of every area of the visual processing system by a developmental optometrist to detect post-trauma vision syndrome, visual midline shift syndrome, light sensitivity, double vision and other functional vision issues, however, takes much longer. It is usually done over three appointments.

### First exam

The first exam takes about 40 to 60 minutes and includes the following:

- evaluating your visual system
- taking a look at your eyeglass prescription
- measuring how your eyes coordinate, both at a distance and close up
- checking to see if you need any prism in your glasses
- finding out how well your eyes are focusing
- looking to see if any tint is necessary in your glasses to help with dizziness or light sensitivity

This first exam may need to be broken into 2 or 3 visits for very dizzy people.

## Second exam

The second exam looks at the health of your eyes and takes about 20 to 30 minutes. It investigates whether or not any of your double vision or dizziness issues are related to eye health. The doctor will look at the front surface, lens and cornea and then dilate the eye to get a good picture of the retina.

It is important to arrange for someone to drive you home after the first 2 appointments. The first exam can make dizzy people really dizzy. Your vision will be blurry for several hours after the second exam making it unsafe to drive.

## Third exam

### Third exam

The third exam maps out the visual field. Visual field, also called field of vision, refers to the entire area that can be seen without moving your eyes. Many measurements are taken to evaluate your central and peripheral (side) vision.

This test determines any loss or impingement on the optic nerve and its pathway. If a problem is revealed, the patient is referred on to an ophthalmologist for further investigation.

### Subjective Visual Vertical (SVV) Test

This test evaluates one of the inner ear organs responsible for sensing gravity (utricle). During the SVV test you may be in a dark room to determine when a projected image of a rotating line is oriented in a vertical or horizontal position. This test has been found to be useful for patients with **vestibular neuritis**, injury to the inner ear, or injury to the nerve that transmits information from the inner ear to the brain. Other devices are being developed to measure SVV.

## Glossary

**Brainstem** – part of the brain that integrates and sorts sensory information

**Central nervous system** – part of the nervous system that consists of the brain and spinal cord

**Cerebellum** – (Latin for “little brain”) part of the brain that coordinates and regulates movement,

**Computerized tomography (CT)** – diagnostic test that can reveal details, for example the inside of the ear and hear, not seen in conventional X-rays. Another term for this test is computerized axial tomography (CAT) scan.

**Computerized dynamic posturography (CDP)** – diagnostic test that measures postural control while standing in either static or dynamic conditions

**Electrocardiogram** – also called an EKG or ECG) test that records the electrical activity of your heart to check for signs of heart disease

**Electronystagmography (ENG)** – diagnostic test to detect involuntary movement of the eye (nystagmus). Eye movements are recorded using electrodes placed on the external eye muscles

**GANS sensory organizational performance (SOP) test** – non-invasive test that looks at overall balance performance

**Magnetic Resonance Imaging (MRI)** – diagnostic technique the produces computerized images of the internal tissues of the body using a large circular magnet and radio waves to generate signals from atoms in the body

**Neurological tests** – series of simple questions and tests to look for abnormalities in the nervous system

**Nystagmus** – involuntary, rapid, back-and-forth movements of the eyes

**Otoliths** – collective name for two structures in the inner ear (**saccule** and **utricle**) that sense gravity and linear acceleration

**Sacculle** – one of two **otolith** organs, the sacculle provides information about vertical acceleration (such as when in an elevator).

**Semicircular canals** – three interconnected curved tubes in the inner ear that detect rotation movement

**Temporal bone** - compound bones forming part of the sides and base of the skull. They surround the organs of hearing

**Ultrasound** (also called sonography) – an imaging technique that uses high-frequency sound waves to produce images of structures within the body

**Utricle** – one of two **otolith** organs, the utricle is sensitive to changes in horizontal movement

**Vestibular Evoked Myogenic Potential (VEMP) test** – diagnostic test to assess if the otoliths, as well as the two branches (inferior and superior) of the vestibular nerve are intact and working normally

**Vertigo** – the specific sensation that you or your surroundings are spinning or tilting

**Vestibulo-ocular reflex (VOR)** – reflex responsible for stabilizing images on the eye during head movement

*Handout updated October 2019*

If you find the information in this handout valuable, **we ask you for your help**. The cause of supporting those affected by balance and dizziness disorders with up-to-date, evidence-based information written for Canadians, needs you.

Will you consider becoming its champion by making a gift online or by mail?

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