

# What is an Audiovestibular assessment?

Information and advice for patients



Science and care combined

## What is an Audiovestibular assessment?

Audiovestibular studies examine hearing and balance. Both the auditory and vestibular sensory organs are located in the inner ear and this means that defects of one organ may affect the other; hence it is often necessary to assess both systems.

To assess the auditory system (hearing), several tests are performed to assess the integrity of the outer, middle and inner ear, and the nerves which conduct the sounds to the brain as electrical signals.

To assess the vestibular system (balance), tests are performed to detect and diagnose disorders of the peripheral and central vestibular function, which can cause vertigo, imbalance and dizziness.

Patients are often required to have several different hearing and balance tests to correctly diagnose a problem as each test performed provides a piece to the puzzle. An appointment might take up to 2.5 hours depending on how many tests are required.



*Videonystagmography (VNG)*

Audiovestibular tests available at Wimbledon NeuroCare include, but are not limited to:

- Pure-tone Audiometry
- Loudness Discomfort Levels
- Tympanometry and Acoustic Reflex Measurements
- Otoacoustic emission studies including SOAE, TEOAE, DPOAE and contralateral suppression of OAE
- Auditory Brainstem Evoked Responses (ABR)
- Cortical Evoked Response Audiometry (CERA)
- Videonystagmography (VNG) Eye Movement recordings and Rotation tests
- The Bithermal Caloric test
- Vestibular Evoked Myogenic Potentials (VEMP)
- Posturography

### Pure-tone Audiometry

This is a subjective test of the hearing thresholds in each ear. You will be asked to wear headphones and press a button every time you hear a tone, even if it is very faint. Occasionally, you may hear a rushing sound in the opposite ear which you should ignore. The test takes about 20 minutes to complete.

### Bone Conduction Audiometry

When a hearing loss is detected, bone conduction audiometry can help to determine whether it is due to a middle ear or an inner ear abnormality. This is done in the same way as pure tone audiometry except that the sounds are delivered to the test ear via a bone vibrator which is placed on the bone behind each ear. When needed, rushing sounds to the opposite ear are delivered via a headphone. The test takes about 15 minutes to complete.

### Loudness Discomfort Levels (LDLs)

This is a subjective test which is used to determine the level at which tones of different pitches become uncomfortably loud. The information is important for fitting hearing aids and for patients who complain of increased sensitivity to loud everyday sounds. The test takes about five minutes to complete.

## **Tympanometry and Acoustic Reflex measurements**

This test of the integrity of the ear drum and middle ear structures helps to determine various common abnormalities of the middle ear, for example ear infection or stiffness of the middle ear bones. A soft plastic plug will be placed in turn into each ear canal. You will hear a sound and feel a slight change in air pressure. You do not need to do anything, except sit still. The test takes about 10 minutes to complete.

An acoustic reflex test is performed immediately after a tympanometry test and uses the same equipment. With the plug inserted in the ear, you will hear several tones at a moderately loud level. You will be asked to sit very still whilst the movement of the ear drum in response to the tones is recorded. The recording provides information about the integrity of the auditory pathways from the inner ear to the brain. The test takes about five minutes to complete.

## **Otoacoustic Emission Studies (OAE)**

Otoacoustic emissions are low-level sounds generated by a healthy inner ear. The mechanism by which the ear generates sound helps to enhance the sensitivity of the ear and aids discrimination between sounds. This test is highly effective for screening the hearing of newborn babies. In older children and adults, it is used to establish or confirm hearing sensitivity, to evaluate patients who have tinnitus, to monitor changes to inner ear structures caused by ototoxicity (damage to the ear by toxin) and to distinguish between sensory and neural hearing impairment.

To record the OAE, a small earplug is inserted into the ear and sound is delivered. You will be asked to stay still and quiet and are not required to respond in any way.

Several types of OAE may be recorded, which provide different clinical information:

### **Spontaneous Otoacoustic Emissions (SOAE)**

Spontaneous emissions of sound are present in most, but not all, healthy inner ears. To record the SOAE, click sounds are delivered to each ear. In normal hearing ears, the presence of peaks in the response can sometimes be perceived as mild tinnitus, which may be

reassuring to the patient. The test takes ten minutes to complete.

### **Transient Evoked Otoacoustic Emissions (TEOAE)**

This is the most widely used OAE test, and is obtained by delivering a click stimulus to each ear. In adults it is mainly used as an indicator of a healthy inner ear and of normal or near normal hearing, but a mild hearing impairment can diminish the response. The test takes about 15 minutes to complete.

### **Distortion-product Otoacoustic Emissions (DPOAE)**

DPOAEs are obtained by presenting two tones simultaneously to the ear over a range of frequencies. This test complements the TEOAE response but provides information about the state of the inner ear over a wider range of frequencies and over a greater degree of hearing loss. The test takes about 20 minutes to complete.

### **Contralateral suppression of OAE**

OAE, which are low level sounds produced by the ear, can be slightly weakened by contralateral noise stimulation if nerve pathways from the brain to the ear are intact. To measure the effect, the OAE are recorded alternately with and without the presence of noise in the opposite ear and the respective responses are compared. This test helps to clarify the nature of certain neural abnormalities. The test takes about 30 minutes to complete.

## **Auditory Brainstem Evoked responses (ABR)**

This electrical response is triggered in response to click sounds, which are introduced to the ear, and give information of the integrity of the auditory pathways from the inner ear to the brain. The test is useful in assessing whether there is interference with the way sounds are conducted to the brain, for example by a tumour, or whether the conduction of sound is slowed down, as in demyelinating disease and other neurological disorders.

First of all, the skin is cleansed with a gel to remove any oil on the surface. Electrodes are then taped to the forehead and behind the ears. You will be seated in a comfortable chair whilst click sounds are delivered to the ears through headphones. The electrodes will

measure the responses from the inner ear and auditory nerve, which are displayed on a computer screen. You will not experience any discomfort during or after the test. The test takes about 30 minutes to complete.

### **Cortical Evoked Response Audiometry (CERA)**

This is an electrical response triggered by tones at different pitches, which are delivered to the ears via headphones. The electrical signals that are triggered by the sounds are produced in the area of the brain specialised to process sound. Cortical evoked response audiometry can be used to test hearing without an active behavioral response. This makes the test particularly useful for evaluating hearing thresholds in difficult to test children and adults, when responses via pure-tone audiometry cannot be obtained.

First of all, the skin is cleansed with a gel to remove any oil on the surface. Electrodes are then taped to the top of the head and behind the ears. You will be seated in a comfortable chair whilst sound (tone pips) are delivered through headphones at various levels and pitches, and the response is displayed on the computer. A typical appointment will take up to one hour. It may be necessary to arrange another appointment if not all information is gathered during the first.

### **Videonystagmography (VNG)**

In everyday life, movements of the head result in opposite movement of the eyes in order to maintain stable vision. The connections between the visual and vestibular system enable us to study the vestibular system by studying eye movements. VNG is a technique for recording eye movements, in response to various stimulations. To have a VNG test, you will be seated on a comfortable chair in a darkened room. You will be asked to wear goggles upon which a camera is fitted over one eye; this picks up your eye movements. The eye movements are seen and analysed by a computer. Using VNG, a vestibular assessment is carried out, which consists of the following:

#### **Eye Movement recordings**

During this test you will be asked to follow one or

several lights which will be projected onto a screen in front of you, whilst keeping your head still. In conjunction with other tests, the information from this test is used to detect any asymmetry in the function of the two vestibular systems and can provide indications of abnormality of brain structures which control the eye movements. The test takes about 20 minutes to complete.

#### **Rotation tests**

In this test eye movements are recorded in response to movements of the chair in which you will be seated. The tests are carried out in darkness with both eyes covered, but remaining open in order to record the resulting eye movements. Seated in a comfortable chair, and secured with seat belts around your waist and feet, you will be asked to think about a task that will keep you mentally alert during the test, such as counting. At first, the chair will move from side to side and the speed will increase up to four levels, with a short break between each increase. The audiologist will stop the test at any time if you do not wish to go on. In the second part, the chair will rotate to the left for one minute at a constant speed. During that time, you may feel that you are moving, but this feeling usually subsides after a while. The chair will then stop for about one minute. When the chair stops, you will initially feel that you are turning in the opposite direction but this feeling will also subside after a while. The same procedure will be repeated to the right. The movement of the chair produces eye movements which are analysed by the computer and provide information about asymmetries between eye movements generated when the chair is rotating to the left and right. The test takes about ten minutes to complete.

## The Bithermal Caloric test

This test helps to determine whether the vestibular organs in the two ears are equally sensitive, or whether one side is weaker than the other, for example as a result of an infection or a virus affecting the inner ear. Any such asymmetry can produce symptoms of dizziness.

The back of the chair will be lowered such that you will be lying down almost flat, but with the head slightly raised. Wearing goggles covering both eyes, eye movements are then triggered by the gentle irrigation of warm and cool water into each ear canal for 30 seconds. The warm water is 7°C warmer than body temperature and the cool water is 7°C cooler than body temperature. The temperature change causes fluid movement inside the outermost semi-circular canal. Following each irrigation, you will be asked to keep your eyes open and to carry out a mental alertness task, such as counting backwards. You may feel a temporary sensation of dizziness and/or slight nausea after each warm or cool irrigation, but this is a normal reaction and should not last for more than a few minutes. Between irrigations you will be given a few minutes break. The test takes about 45 minutes to complete.

## Vestibular Evoked Myogenic Potentials (VEMP)

The VEMP is a computerised test of the integrity of the saccule, one of the vestibular sensory organs in the ear, and its neural connections. It's a relatively new development and together with other tests, it helps provide a more complete evaluation of the vestibular system than was previously possible.

First of all, the skin is cleansed with a gel to remove any oil on the surface. Electrodes are then taped to the forehead and muscles in the neck. You will be seated in a comfortable chair whilst relatively loud tones are delivered to the ears through headphones, for less than a minute at a time. When you hear the tones you will be asked to turn your head sharply in one direction and keep it turned whilst they are heard, in order to tense up the muscles in your neck. The test takes about 30 minutes to complete.

## Posturography

Maintaining balance whilst standing or walking depends on the integrity of several systems: the vestibular system in the ears, visual cues and the information obtained from pressure receptors in our muscles, joints and the soles of our feet. Posturography gives a measure of your overall balance, and helps to separate out and assess the functioning of these various input systems, and how they are integrated in each individual. The test is particularly useful in patients who feel dizzy when standing or walking. It also provides a baseline for comparison before a vestibular rehabilitation course.

You will be asked to stand on a metal platform without your shoes. Before the test starts you will wear a safety harness which is secured to a metal frame above.

### Sensory Organisation test

The most widely used test is the sensory organisation test. To perform the test, pressure detectors under the platform will measure your centre of gravity and sway whilst you stand upright with your eyes open, and then with eyes closed. This is repeated with the surround moving slightly backwards and forwards, and with the platform moving slightly. Any sway movements from your normal centre of gravity are recorded and analysed by the computer. The test takes about 45 minutes to complete.

### Motor Control test

The Motor Control test is carried out immediately after the Sensory Organisation test in patients who experience difficulty maintaining balance on uneven surfaces. The balance platform underneath your feet will move slightly but suddenly, to evaluate how you cope with unexpected changes to the walking surface. Information from this test can be used for devising appropriate rehabilitative strategies. The test takes about 45 minutes to complete.

**Where possible, your assessment, tests and post-test analysis will be arranged consecutively on the same day. All test results are reviewed by the Consultant Audiovestibular Physician.**

### **Do I need any preparation for the assessment?**

The following advice concerns a number of audiovestibular tests, however, when you book your appointment you will receive more detailed information on how to prepare.

- Certain medications may affect the results of the testing and should therefore be avoided for at least 48 hours prior to your testing. Ask your Audiovestibular Physician for further details on what medication you may keep taking, and which to avoid
- Remember to bring a list of all the prescription medicines you take on the day of your test
- Avoid alcohol for 24 hours before your test
- Please arrive in good time with eye make-up removed and hair free from hair spray and gels
- For ear examinations, if you have a problem with excess wax, you will need to have this removed professionally before your test. GP's will do this free of charge. If you decide to have this done at your appointment, please note that there will be an additional charge
- Let us know if you suffer from any allergies
- You may eat in advance of your test, but we suggest a light meal only
- Wear comfortable, loose fitting clothes and socks. Women should wear trousers rather than dresses or skirts
- Avoid wearing high neck clothing, as some tests require electrodes to be taped to the shoulders, forehead, and neck
- If you have severe neck problems that may prevent you from performing the test, please make the audiologist aware
- Have someone accompany you home in the event you need assistance due to dizziness. Please note that we will not be able to discharge you alone if you are feeling unwell

### **How long will it take and when does my doctor get the results?**

An appointment may take up to three hours depending on how many tests are required. Results will be sent to your consultant within 48 hours who will discuss them with you during your follow-up appointment.

### **What will I feel during the assessment?**

You may experience dizziness with some of the tests. Electrodes may feel a little cold when applied due to the paste applied.

### **Are there any side-effects or risks?**

There is a minor chance of a skin reaction, due to the paste or sticky tape used. You may experience dizziness with some of the tests.



**For information or to book an appointment:**

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