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Balance and Dizziness

For the Professional

Introduction to Videonystagmography (VNG)

Interacoustics

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Introduction to VIDEO nystagmography (VNG)

Few people realize that the balance system is the system that is responsible for every sense of motion that humans have. Whether standing up, lying down, walking forward, riding in an elevator or driving a car, it is the balance system, together with input from your eyes that gives the brain a sense of where the person is in space. Whenever a person complains of being "dizzy", it is often a problem with the balance system that is responsible for that person's symptoms. As anyone who has ever had problems with their balance system can attest, a problem with your balance system will cause problems in every other aspect of your life!

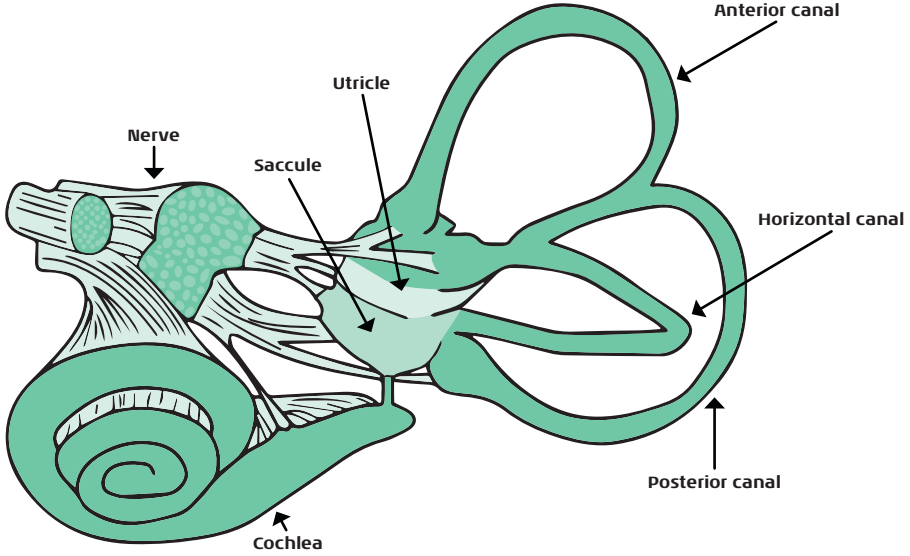
The clinical term for the balance system is the "vestibular" system. The vestibular system is housed within the inner ear and shares connections with the hearing (auditory) system. The vestibular and auditory systems have several characteristics in common:

- Both systems are encased in the same part of the skull – just above and slightly behind each ear
- Both systems are fluid-filled organs
- Both systems have tiny hair cells within them that are forced to move by the motion of the fluid around them
- Both systems depend on the inner ear's ability to convert the mechanical energy of the hair cells to electrical energy that can be used by the brain to gather information

It is not unusual that if one of these systems is affected by illness, so might the other be affected. It is common for a "dizzy" patient to also have hearing loss and/or ringing or buzzing in the ears. Similarly, a problem with the balance system may also cause abnormal eye movement as the brain tries to decipher why it is receiving inappropriate information.

The main difference between the vestibular system and the auditory system is that the vestibular (balance) system is a much more intricate structure than is the auditory (hearing) system. Each of the vestibular systems is comprised of five parts: the utricle, the saccule and three semi-circular canals – each of which is responsible for detecting a specific plane of motion. Any or all of these parts could be affected by illness and cause balance problems.

It is important to understand that the brain relies on equal-but-opposite input from each of your vestibular systems. The vestibular systems are mirror images of each other. The benefit of this is that when one side of the vestibular system is sending excitatory information to the brain, the other side is sending an equal amount of inhibitory information to the brain. If one of the vestibular organs is weak, it can't send an equal amount of energy to the brain and the brain senses a mismatch in the information that it is receiving – resulting in dizziness.



The vestibulo-ocular reflex (VOR) is also an integral part of the "balance" system because the brain relies on information from the ocular system as much as it relies on information from the vestibular system. The VOR is a reflexive eye movement that occurs in response to head movement. This reflex allows humans to focus on a stationary object while the head is in motion. Dysfunction of the VOR often results in complaints of chronic unsteadiness, feelings of "motion sickness" and disorientation. These complaints are not uncommon in geriatric patients and are often attributed to a breakdown in neural firing of the VOR.

The diagnosis and treatment of vestibular disorders requires a network of medical professionals that often includes a primary care physician, an ear specialist, an audiologist and a physical or occupational therapist. These professionals will likely use the "puzzle" approach to diagnosing the problem by putting together small pieces of information collected from physical examinations and from specialized testing of the vestibular system. These tests can pinpoint whether the problem stems from the inner ear (which is often medically treatable) or if the problem stems from the brain. The end result of the assessment allows the appropriate recommendations to be made for treatment of the balance problem.

VNG Test Battery

Because the vestibular system is such an intricate system, there is not a single test that can diagnose vestibular disorders. Rather, an assessment of the vestibular system requires a battery of tests – each stimulating a particular anatomical structure in an effort to tax that structure, probing for dysfunction.

The suggested protocol for vestibular disorders is as follows:

- Thorough patient interview
- Otoscopy
- Complete Audiometric Studies
- Bedside Examination
- Vestibulonystagmography (VNG)
  - Spontaneous nystagmus
  - Gaze evoked nystagmus
  - Smooth pursuit tracking
  - Saccade testing
  - Dix-Hallpike Maneuver
  - Positional testing
  - Caloric irrigation

Patient Interview

Prior to a vestibular assessment, it is imperative to obtain a thorough and pointed case history. It is recommended that the patient complete a written questionnaire prior to the visit, however, a written questionnaire is simply a starting point from which you should base your patient interview. Below is a list of questions that are helpful in the vestibular assessment:

- Describe your symptoms to me without using the word "dizzy".
- Have you recently been ill?
- Have you had a recent change in medications?
- Can you associate any unusual ringing or buzzing in your ears when you are dizzy?
- Do you experience symptoms every time you move your head in a certain manner (looking up, lying down, bending over, etc...)?
- If so, can you associate that your symptoms occur only when you turn your head or lie down on one side?
- Do you associate a "stuffy" feeling in one or both ears when you are having dizziness?
- (If the problems seems to be related to head position) Do you have a brief burst of dizziness a few seconds after you lie down that goes away if you lie still?

With practice, each of these questions will lead the examiner toward a more efficient assessment and therefore, better patient care.

Complete Audiometric Studies

Because the auditory and the vestibular systems are both housed within the temporal bone, it is not surprising that if one of these systems is affected by disease, so, too, will the other be affected. Therefore, it is imperative that a complete audiometric study be performed on the patient, preferably when the patient is symptomatic. This study should include:

- Otoscopy
- Tympanometry
- Acoustic reflex measures
- Pure tone thresholds (air conduction and bone conduction)
- Speech discrimination measures

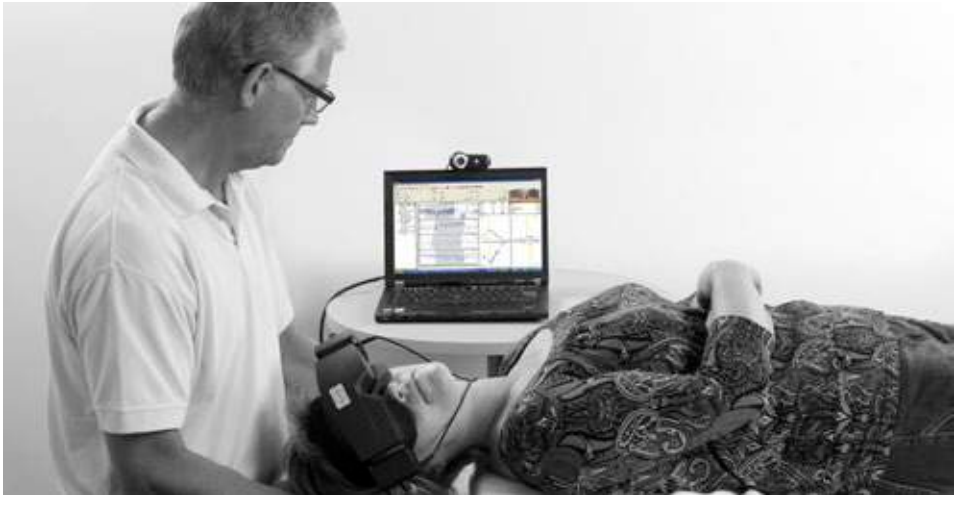
A thorough visual examination of the ear is necessary to detect any debris that might interfere with audiometric and caloric testing. If debridement is warranted, it should be done prior to any further testing. Tympanometry will ensure that the patient's ear canal is patent and that the middle ear is functioning properly. Pure tone threshold testing and speech discrimination measures will reveal whether an asymmetry between auditory systems exists and if so, to what degree.

Video nystagmography (VNG)

Thus far, the examiner should have collected sufficient information from the assessment to hypothesize whether the vestibular site of lesion is peripheral or central in origin. The VNG battery will usually provide conclusive evidence of the examiner's hypothesis. There are three portions to the VNG: ocular tests, positional tests and caloric irrigation. The ocular tests help the examiner to rule out the presence of underlying spontaneous nystagmus and help to assess the central vestibular pathways. The positional tests help the examiner to determine whether the patient's complaints are related to the position of the head in space and relative to the body. Caloric irrigation analyzes the intensity of the patient's vestibular response on each side and determines whether there is symmetrical vestibular function between the two vestibular systems.

VNG Setup

The VNG examination room should have an examination table and/or fully reclining chair that will allow the patient to lie comfortably but will also allow for positioning of the patient. The computer monitor should be positioned so that the examiner can easily visualize the patient's eye movements and subsequent tracings. It is important that the examiner have sufficient space on all sides of the table to maneuver. Place the goggles on the patient so that they are snug, but not uncomfortable.



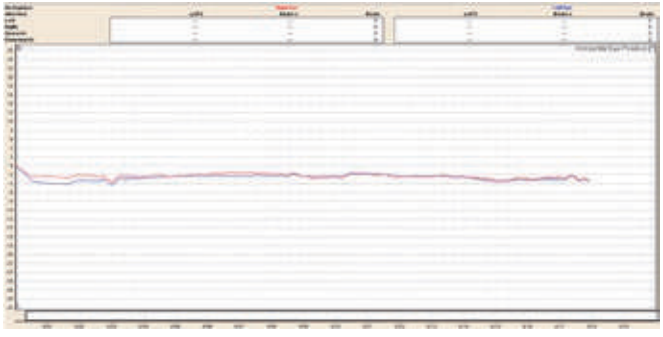
VNG Test Battery

Spontaneous Nystagmus
Purpose of Test:
The presence of spontaneous nystagmus can affect all other test results. Therefore, it is essential to identify the presence of spontaneous nystagmus prior to performing any other VNG tests.

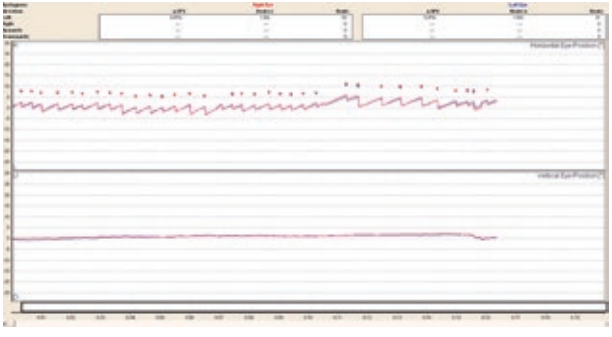
Patient Instructions:
"I am going to place a mask over the goggles. What I need for you to do is just look to where you think is straight ahead."

What to Expect:
A patient with no spontaneous nystagmus will produce a tracing that is virtually a straight line. The right eye is represented by the red line and the left eye by the blue line. If nystagmus is present it will be identified by a triangle on the graph and the values of the nystagmus will be plotted in the table.

Conclusion:
The presence of spontaneous nystagmus may be further analyzed to differentiate central versus peripheral vestibular involvement.



Example of "normal" spontaneous nystagmus results nystagmus results



Example of "abnormal" spontaneous

Gaze Test

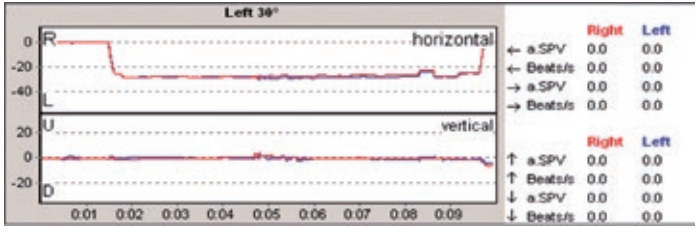
Purpose of Test:
To assess the patient's ability to maintain a steady gaze on an object without the eye generating extraneous movements (i.e. square wave jerks or nystagmus). The inability to maintain a steady gaze is an indication of either a central or peripheral vestibular system lesion. Parameters tested are: primary (straight ahead), gaze left, gaze right, gaze up and gaze down.

Patient Instructions:
"You will see a yellow dot on the screen (or wall or monitor). Simply look at the dot. If the dot moves, follow it with your eyes only – trying not to move your head."

What to Expect:
A patient with "normal" gaze ability will produce a tracing that is virtually a straight line once the eyes are fixated on the target. The right eye is represented by the red line and the left eye by the blue line. If nystagmus is present it will be identified by a triangle on the graph and the values of the nystagmus will be plotted in the table. An "abnormal" gaze tracing might present itself in several ways. You may see jerk nystagmus, square wave jerks or gaze decay.

Conclusion:
It should be noted that gaze testing is the only one of the four ocular tests in which an "abnormal" finding could be due to either a peripheral or a central vestibular lesion.

Gaze Test
- Examples of test results



Example of "normal" gaze test results

Left gaze test showing congenital nystagmus in the horizontal channel

Example of gaze nystagmus in ms showing the need to use both cameras

Smooth Pursuit

Purpose of Test:
To assess the patient's ability to accurately track a visual target in a smooth, controlled manner. Smooth pursuit tracking assesses the patient's central vestibular system. Although several methods of smooth pursuit tracking have been researched, it is the controlled-velocity method that has been proven to be the most clinically useful; therefore, it is the controlled-velocity method that is described in this booklet.

Patient Instructions:
"You will see a yellow dot on the screen (or wall). The dot will move from one side of the screen to the other with a smooth, predictable motion. Your task is to follow the dot with your eyes while keeping your eyes precisely on the dot – try not to move your head and try not to get "ahead of" or "behind" the target."

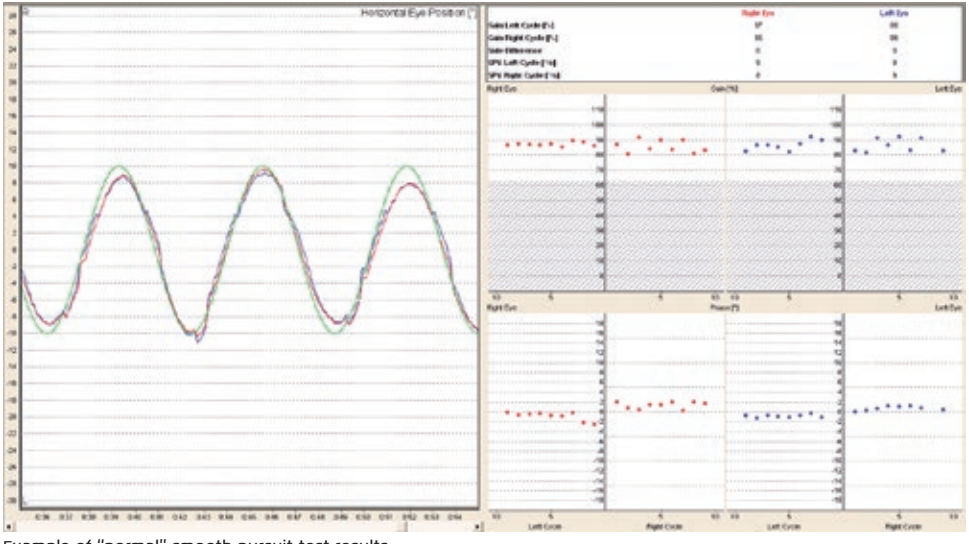
What to Expect:
A patient with the ability to perform smooth pursuit tracking normally will produce a tracing on which the stimulus and the response are virtually identical and appear overlapped. The stimulus is represented by the green line, the right eye is represented by the red line and the left eye by the blue line. The responses for each cycle of the pursuit are represented on the graph by red dots for the right eye and blue dots for the left eye. Responses that are within normal limits will fall in the white area and responses outside the normal limits will fall in the grey area.

Abnormal Test Results:
It is important to know that the smooth pursuit tracking test is the most sensitive of the ocular tests to age-effect (i.e. older patients are more likely to produce errors during the performance of the task). Also, unlike saccades, where the movement of the eye is something that is unconsciously done many times throughout the day, the smooth pursuit tracking task is something that may need to be "taught" to the patient. Therefore, it may be necessary that the patient be given one or two "trials" of the task prior to an actual recording (unless the patient performs the task accurately at the first trial).

Conclusion:
Smooth pursuit tracking is an ocular test used to determine whether there is central pathology that is precluding accurate tracking of moving targets by the eyes. Smooth pursuit tracking is susceptible to an age-effect and may require that the examiner acclimate the patient to the task prior to recording. For a complete discussion of differential diagnosis using smooth pursuit tracking, refer to: Jacobson GP, Shepard NT. Balance Function Assessment and Management. San Diego; Plural Publishing, 2008.

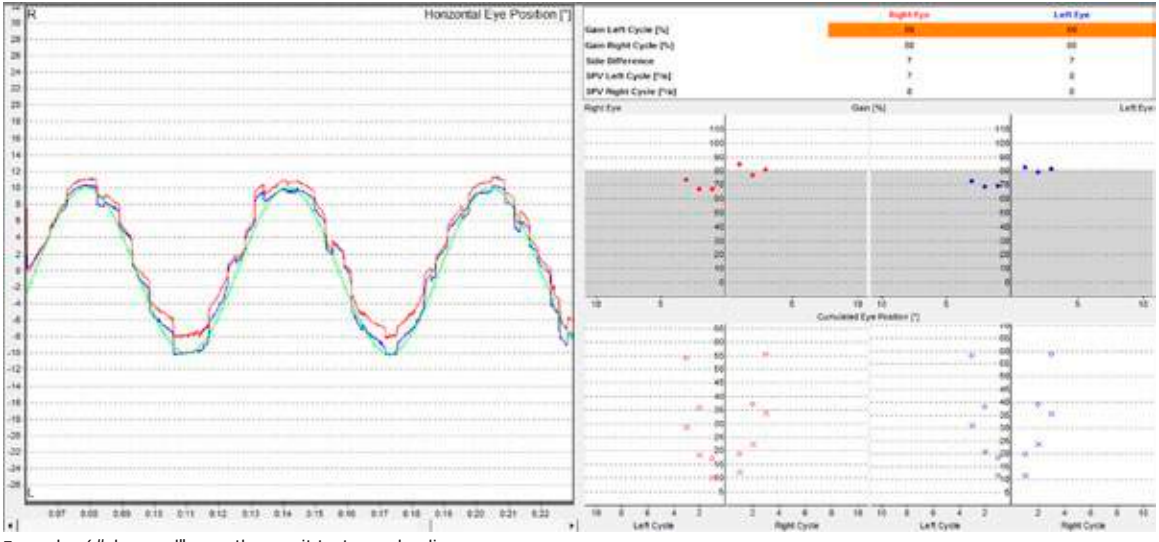
*NOTE: It is important to remember that it is not within the audiologist's scope of practice to diagnose disease. An audiologist is limited to simply stating whether documented test results indicate a dysfunction of either the central or peripheral vestibular system. Official diagnosis should be deferred to the patient's physician.

Smooth Pursuit
- Examples of test results



Example of “normal” smooth pursuit test results

Smooth Pursuit
- Examples of test results



Example of "abnormal" smooth pursuit test cogwheeling

Saccades

Purpose of Test:
To assess the patient's ability to accurately move the eyes from one designated focal point to another in a single, quick movement. The ability to accurately perform saccade testing assesses the patient's central vestibular system. The random saccade paradigm has been established as the most useful of saccade testing; therefore, it is the random saccade test that is discussed in this booklet.

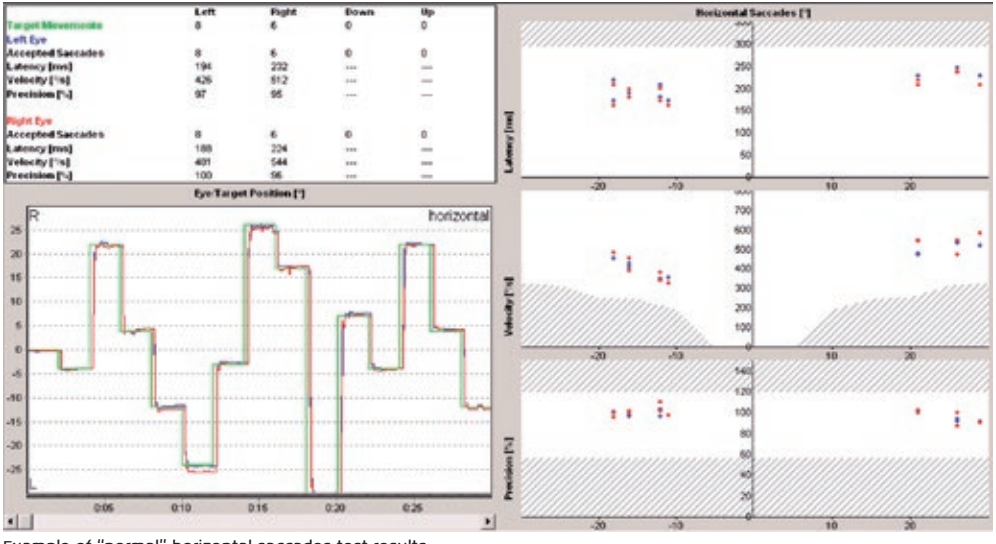
Patient Instructions:
"You will see a yellow dot on the screen (or wall). Simply look at the dot. If the dot moves, follow it with your eyes only – try not to move your head."

What to Expect:
A patient with the ability to perform a saccade test normally will produce a tracing on which the stimulus (green line) and the responses (red line for right eye and blue line for the left eye) are virtually identical. Each saccade is represented by a dot on the graph. Dots in the white area are within normal range and dots in the grey area are outside of the normal range.

Abnormal Test Results:
The analysis of the saccade test considers three parameters. They are:
- Latency – how long it takes the patient's eyes to find the target
- Accuracy – whether the patient can move his eyes exactly to the target without "overshooting" or "undershooting" the target
- Velocity- how fast the eyes are moving from point to point

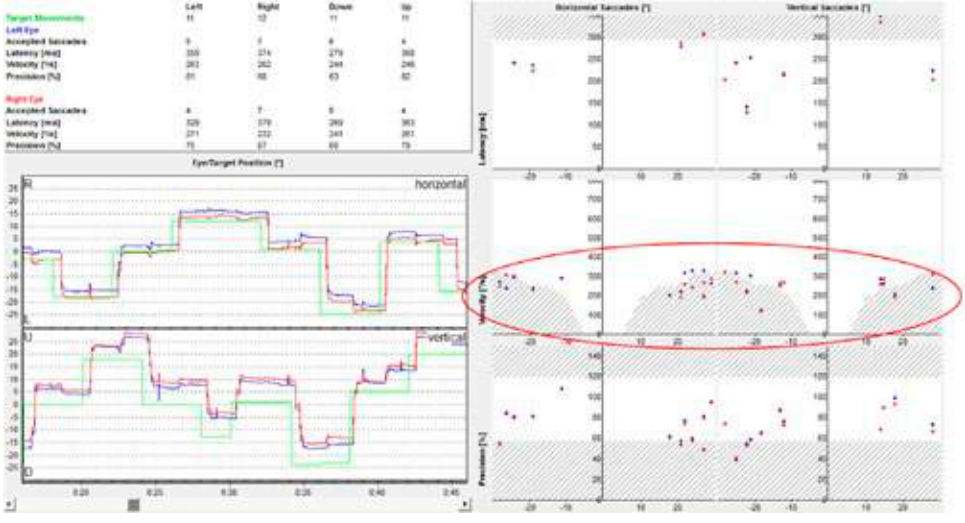
Conclusion:

Saccade testing is an ocular test used to determine whether there is central pathology that is precluding accurate fixation of the eyes onto moving targets. Each of the saccade subtests can give anatomy-specific information about the patient's central vestibular system.

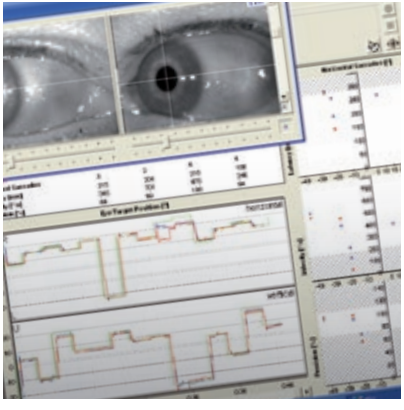


Example of "normal" horizontal saccades test results

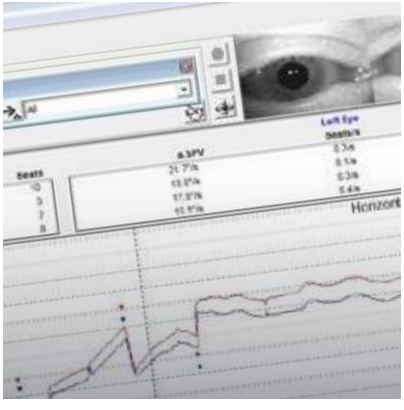
Saccades
- Example of test result



Example of Saccade test with "abnormal" velocities, both horizontal and vertical targets



Saccade test window with enlarged eyes



Video playback

USB foot pedal

Optokinetics

Purpose of Test:
The optokinetic reflex allows the eyes to follow objects in motion while the head remains stationary. This function is performed within the central vestibular system. The inability to produce symmetric optokinetic nystagmus (OPK) implies a dysfunction of the central vestibular system. It should be noted that in order to have a valid OPK test you must stimulate the entire visual field of the person being tested, that is why a video projector or large LCD screen is needed and where lightbars have drawbacks.

Patient Instructions:
If the test is set up to maximize the patients visual field then very little instruction is needed, since the response is a "reflex" it should happen on its own with little intervention. The patient is instructed to "simply look ahead and watch the pattern in front of you".

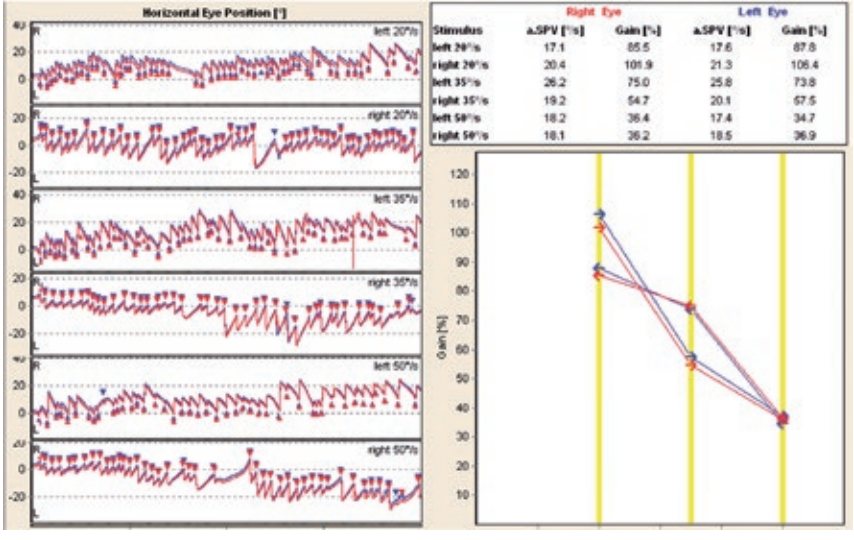
What to Expect:
OPKs are measured to the right and to the left at varying velocities. A patient with the ability to perform OPKs normally will produce tracings that are fairly symmetrical in left and right movement with "beats" that are relatively uniform in appearance. Abnormal differences in SPV and Gain for each of the target speeds are represented by the orange bar. The values are shown for both the left and right eyes.

Abnormal Test Results:
An abnormal response seen in one direction but not the other is highly suggestive of a vestibular disorder. If not accompanied by a spontaneous nystagmus, the disorder is likely central in origin. When the maximum speed of the slow component is less than 50% of the stimulus speed it is considered abnormal.

*NOTE: It is possible that the patient may be able to accurately track the target in one direction, but not in the other direction. In most cases, the abnormality will present itself toward the side that has the lesion. Also, it is critical that the examiner is aware of whether the patient is actively watching the screen. OPKs are often disturbing to the patient's vestibular system. In an effort to compensate, the patient might try to "stare through" the screen. The result will appear as a "flat-line" on the tracing. This is good information in that it may indicate that the patient has adopted this "stare through" strategy in learning to compensate for the vestibular disorder.

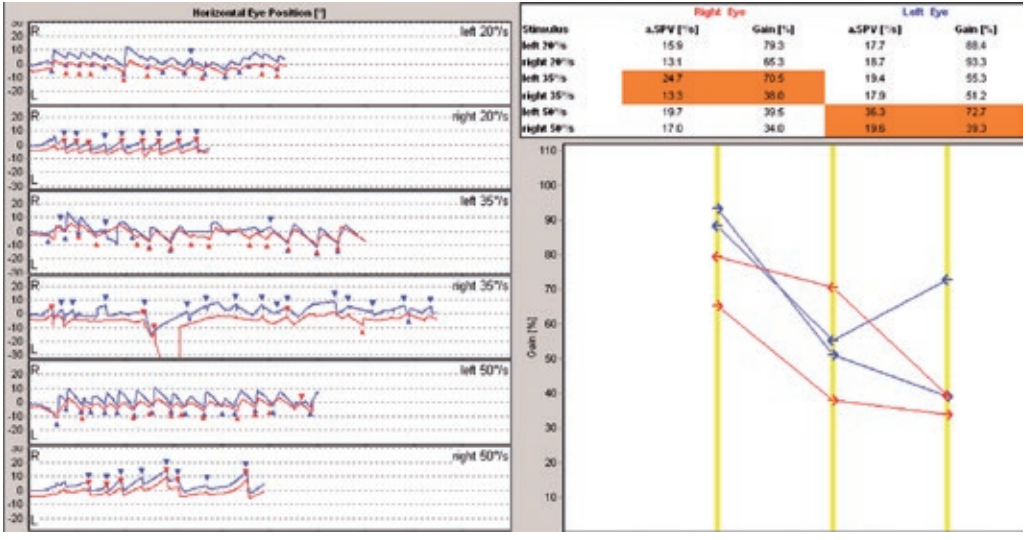
Conclusion:
Optokinetics are used to determine whether there is central pathology that is precluding accurate tracking of moving targets by the eyes while the head remains immobile. Optokinetics, when paired with smooth-pursuit tracking, can give the examiner a more complete picture of central vestibular function.

Optokinetics
- Examples of test results



Example of "normal" optokinetic test results

Optokinetics
- Examples of test results



An abnormal response seen in one direction but not the other is highly suggestive of a vestibular disorder.
If not accompanied by a spontaneous nystagmus, the disorder is likely central in origin. When the maximum speed of the slow component is less than 50% of the stimulus speed it is considered abnormal.

Positional Testing

Purpose of Test:
To determine whether a change of position of the patient's vestibular systems in space provokes nystagmus. Both central and peripheral vestibular lesions can cause positional nystagmus and vertigo, and the examination focuses on distinguishing the two. Most central positional nystagmus is static, in that the nystagmus persists as long as the head is kept in the provoking position. Benign positional vertigo from peripheral vestibular pathology is usually transient. Observations of the direction, latency and fatigability of nystagmus are important diagnostically.

Considerations:
- Positional nystagmus is created by an asymmetry in the tonic resting rate of the two vestibular end organs.
- It is critical to rule out the presence of spontaneous nystagmus prior to positional testing.
- There are many positions in which one might put the patient for examination purposes. The positions described in this paper are considered standard procedure and provide the most diagnostic information.
- Positional testing is performed vision-denied (using covered VNG goggles) so that the patient does not have the means to suppress nystagmus.
- If the patient becomes strongly reactive when he is moved from one position to another, it is usually indicative of a vestibular lesion in the ear that is downward.
- If, within 15 seconds, no nystagmus is noted in the tracing, it is not necessary to continue the recording. However, if nystagmus is noted, it is helpful to continue the recording for at least thirty (30) seconds to watch for decay.
- Positional testing is also used in the diagnosis of benign paroxysmal positional vertigo (BPPV).

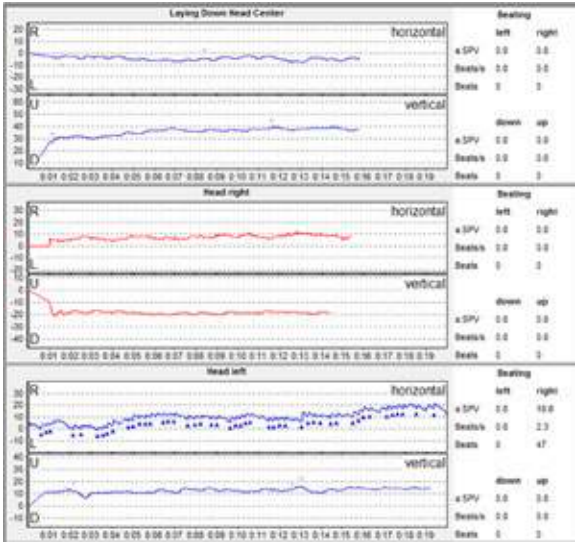
Patient Instructions:
"I am going to place a mask over your eyes. I will then assist you in moving into different positions. It is important to keep your eyes open at all times so that the cameras can record your eye movement."

Description of Positions Tested:
Neutral – Used to rule out spontaneous nystagmus. The patient is in the seated position on the table with vision denied.
Supine – The patient is lying on the table, vision denied, while his head is supported by the examiner and elevated at approximately 30º (the approximate position of the head relative to the body in its natural state).
Head Right/Head Left and Body Right/Body Left – Begin with the patient in the supine position described above. Gently guide the patient's head to one side. Allow adequate time for nystagmus to occur (approximately 15 seconds). If no nystagmus occurs, return the patient to the supine position, then turn the patient's head in the opposite direction and repeat procedure. If nystagmus is noted in either the head right or head left position, immediately ask the patient to roll onto his shoulder toward the side of the effected ear.

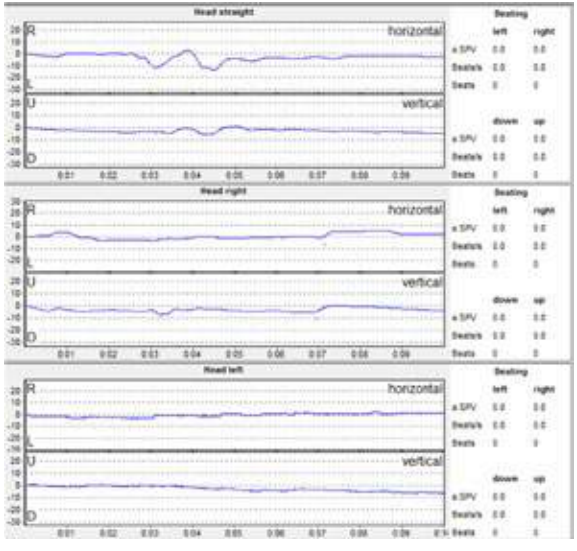
What to Expect:
If the patient does not have positional nystagmus, the tracing will result in essentially a flat line and the values for left and right and down and up beating nystagmus will be zero in each condition.

Abnormal Test Results:
If positional nystagmus is present, nystagmus will be present in the horizontal and/or vertical channels. The nystagmus is represented by the triangles and the averaged values for left and right beating nystagmus and up and down beating nystagmus are shown in the table, including the total number of beats and the beats per second for each test.

Positional Testing
- Examples of test results

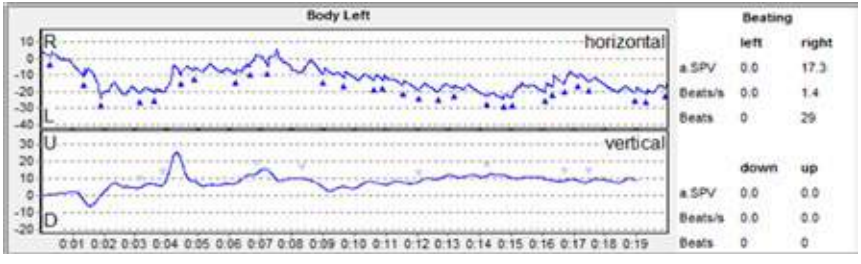


Example of "normal" positional test results



An abnormal positional test.
Head left shows right beating positional nystagmus

Positional Testing
- Examples of test results



Head left nystagmus still present when patient is rotated to the left side,
this rules out cervical nystagmus and confirms positional nystagmus.

Positional Testing

Conclusion:
Nystagmus that persists as long as the provoking position is maintained can occur with either central or peripheral vestibular lesions. Waveforms are helpful. Pure downbeat nystagmus from central lesions is often accentuated in the reclining position, and sometimes may only be noted with this position. The lack of a torsional component differentiates this from anterior canal BPPV. Pure upbeat nystagmus can be positional. Positional torsional nystagmus has been reported with lateral medullary infarction. Other features that indicate central disease are lack of latency, lack of fatiguability, and the inability to suppress nystagmus with vision. Patients with static positional nystagmus without prior evidence of more typical BPPV should be investigated for central disease. Lesions of the cerebellar vermis are especially associated with static positional nystagmus.

Alcohol can induce a static positional vertigo and horizontal nystagmus. Nystagmus beating towards the floor when the patient's head is lying flat on its side emerges within 30 minutes of ingestion, peaking at 2 hours. As the blood alcohol level falls, 4 to 5 hours later, the nystagmus recurs in the opposite direction, and may last up to 12 hours. It is attributed to more rapid diffusion of alcohol into the cupula than the endolymph. The resulting difference in specific gravity temporarily imparts an abnormal sensitivity to linear acceleration, such as gravity.

Dix-Hallpike Maneuver

Purpose of Test:
Serves as a technique for differential diagnosis between positional vertigo and Benign Paroxysmal Positional Vertigo (BPPV).

Patient Instructions:
"I am going to place a mask over your goggles. I need you to cross your arms over your chest and turn your head toward me. At the count of three, I want you to lie back as quickly as you can while keeping your head turned and your eyes open. I will help to support you through the entire process."

What to Expect:
If the patient does not have any form of positional vertigo, the tracing will be essentially a straight line (normal eye movement is expected). If BPPV is present, nystagmus will be present in the horizontal and vertical channels. The nystagmus is represented by the triangles and the averaged values are show in the table including the total number of beats and the beats per second for each test.

Abnormal Test Results:
If the patient displays nystagmus, it is important to watch the video monitor for several characteristics in order to differentiate "peripheral vertigo" from BPPV:

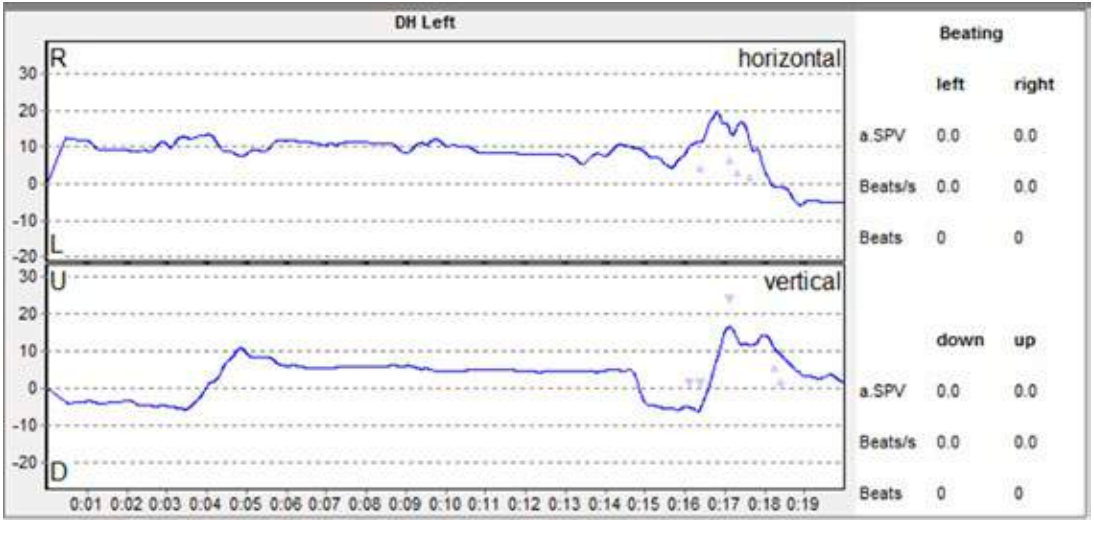
- Does the nystagmus have delayed onset of 2-20 seconds?
- Is the nystagmus a torsional ("rotary") nystagmus?
- Does the nystagmus fatigue after a few seconds?
- Does the nystagmus reverse direction when you return the patient to a sitting position?
- Is the nystagmus less intense upon retest?

Generally, all of these characteristics will present together as an indication of BPPV. If nystagmus is present, but it does not meet these characteristics, there is usually a different peripheral vestibular dysfunction that is the source of the nystagmus.

Conclusion:
The Dix-Hallpike is an indispensable test when a patient complains of positional vertigo. It is a test of the peripheral vestibular system.

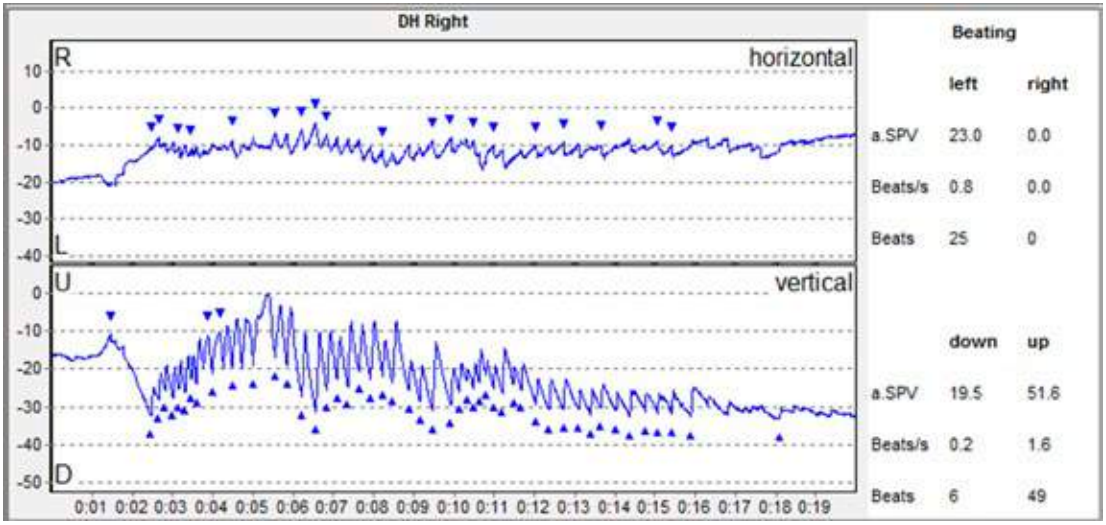
Characteristics of BPPV Evidenced during Dix-Hallpike Maneuver: ("Positive Dix-Hallpike")
- Delayed onset of 2-20 seconds
- Transient burst of nystagmus
- Nystagmus fatigues after a few seconds
- Patient subjective report of vertigo
- Nystagmus reverses direction upon sitting up
- Nystagmus is less intense when immediately retested

Dix-Hallpike Maneuver - Examples of test results



Example of "normal" (negative) Dix Hallpike with the right ear undermost

Dix-Hallpike Maneuver - Examples of test results



Example of positive Dix Hallpike with the left ear undermost.

Caloric Irrigation

Purpose of Test:
The purpose of caloric irrigation is to assess the symmetry of the bilateral peripheral vestibular system and to analyze the excitatory response of each vestibular end organ. The central vestibular system relies on the peripheral vestibular system to provide adequate and equal input from each end organ. When there is asymmetrical function of peripheral end organs or if there is insufficient information from the peripheral end organs, the brain attempts to compensate – resulting in nystagmus. By using caloric irrigation, you are stimulating each end organ (cupula), independently of the other, to determine whether one end organ is weaker than the other (asymmetry) or whether neither end organ is providing sufficient vestibular information to the brain..

Considerations:
- Pre-test instructions/medications – There is debate about whether patients should be asked to discontinue central nervous system suppressant medications for 48 hours prior to the VNG. Part of this debate is that patients often don't understand which medications are allowed and which are not allowed. Therefore, the patient might stop taking ALL medications – even ones that are necessary for their daily health. A general rule of thumb is that the patient should stop taking medications that are prescribed for "dizziness", but continue to take other medications (such as heart medications, blood pressure medications, etc...).
- A thorough examination of the external ear canal is necessary prior to irrigation. The two most important factors to consider are the presence of cerumen and the architecture of the ear canal. If excessive cerumen is present, it might preclude the stimulus from reaching the inner-most portion of the ear canal and could therefore prohibit a reliable test result. Removal of even the smallest amounts of cerumen is beneficial to the testing process. Examination of the shape and curvature of the ear canal is essential to reliable test results for two reasons: (1) Because the irrigator tip is straight and ear canals rarely are, it is not uncommon for the insertion of the irrigator tip to cause discomfort for the patient (2) It is important for the stream of air/water from the irrigator to be directed near, but not directly on, the tympanic membrane to avoid injury to the patient. Without a thorough examination of the ear canal, it is impossible to know whether the achieved test results are an accurate assessment of the vestibular system.

- It is necessary to perform VNG with the patient in a vision-denied state to disallow fixation suppression of the nystagmus response.
- Alerting tasks are also necessary to discourage the patient from fixation suppression. The most effective alerting tasks require the patient to use recall memory – i.e. "name a state that begins with the letter _____..." ,"name a color that begins with ____", "name a city in the state of __________", etc...
- The order in which the irrigations are performed has been thoroughly researched and is thought to be irrelevant. However, general consensus is that it is best to start with warm irrigations (which provide an excitatory response) if for no other reason than if the patient cannot tolerate bi-thermal irrigation, the examiner has AT LEAST enough information to provide a score for the Monothermal Warm Screening Test (MWST).
- MWST is a screening test used mainly for patients who cannot tolerate bi-thermal testing. It is a percentage of asymmetry derived from only the warm-caloric irrigation responses.
- Fixed wait time between irrigations has been proven to be unnecessary (as long as the response from the previous irrigation has completely subsided).
- A "fixation period" of 10-15 seconds is recommended as a diagnostic tool during the recording of the caloric response (at approximately 90 seconds after the onset of irrigation). The inability to suppress nystagmus when a fixation target is provided is considered a pathological indication of central vestibular pathology.
- Because the caloric procedure requires detailed instruction and is sometimes distressing to the patient, it is not recommended for children

Patient Instructions:
"I am going to put warm and cool air/water into each ear. I will begin by putting warm air in the right/left ear. The air/water will sound loud and will feel warm, but it should not be painful. If you experience pain, please tell me immediately. The air/water will be in your ear for approximately 60/30 seconds. After 60/30 seconds, I will take the air/water out of your ear and I will begin to ask you questions. I need two things from you: to keep your eyes open AT ALL TIMES – even if you are feeling dizzy – and focus on the questions that I am asking you to answer. Do you have any questions before we begin?" It is also helpful to reassure the patient that the sensation of motion is to be expected and will not last very long.

What to Expect:
A fully functional peripheral vestibular end organ will begin to respond to stimulation approximately 15-30 seconds into the irrigation procedure and will reach its peak approximately 60-90 seconds from the beginning of the irrigation process. A rule of thumb is that warm air/water will produce nystagmus that beats toward the test ear and cool air/water will produce nystagmus that beats away from the test ear. (COWS – Cold Opposite, Warm Same). The nystagmus beats are represented by the dots plotted on the graph for each condition. The yellow bar indicates the time of maximum performance. Each condition is giving a maximum Slow Phase Velocity (SPV) value and a Fixation Index value (FI). All 4 SPV values are added and a total SPV values is also displayed. The SPV values are used to calculate the overall weakness and determine if any directional preponderance is present.

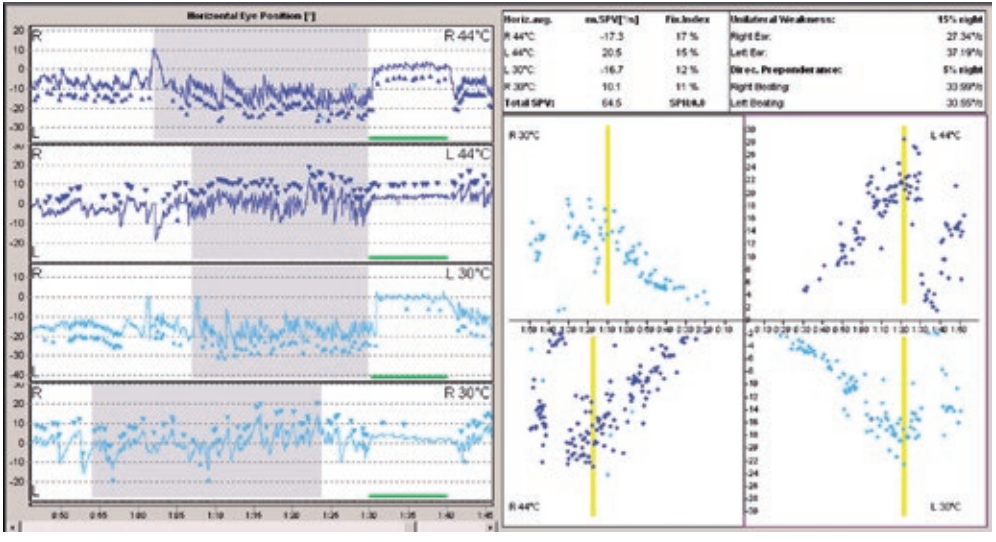
Abnormal Test Results:
Abnormal caloric test results can present in several ways: as an asymmetry between ears (labeled as "unilateral weakness"), as "directional preponderance" ("directional preponderance" numerically expresses how the amount of right-beating nystagmus compares with the amount of left-beating nystagmus) or as a display of symmetrical, but weak, responses from both ears (labeled as "bilateral weakness").

COMMON NORMATIVE VALUES FOR CALORIC RESPONSE PARAMETERS

PARAMETER:	LABELED AS:	COMMON NORM:
Unilateral Weakness	UW%	<25%
Directional Preponderance	DP%	<30%
Fixation Suppression	FI%	<60%
Bilateral Weakness	Each ear <12deg/sec	
Hyperactivity	Each ear >140deg/sec	

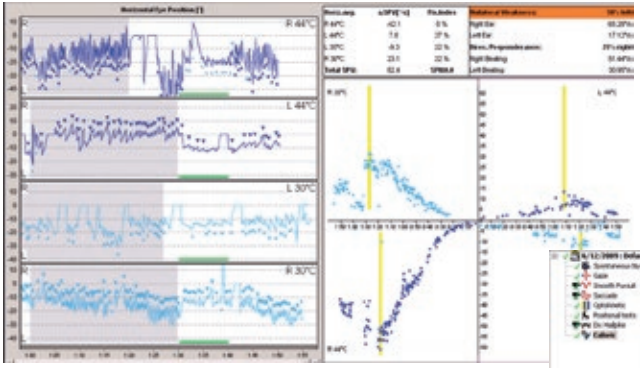
Adapted from Jacobson GP, Shepard NT. Balance Function Assessment and Management. San Diego; Plural Publishing, 2008.
Under the age of 6 or adults with a mental age of <6 years.

Caloric Irrigation
- Examples of test results

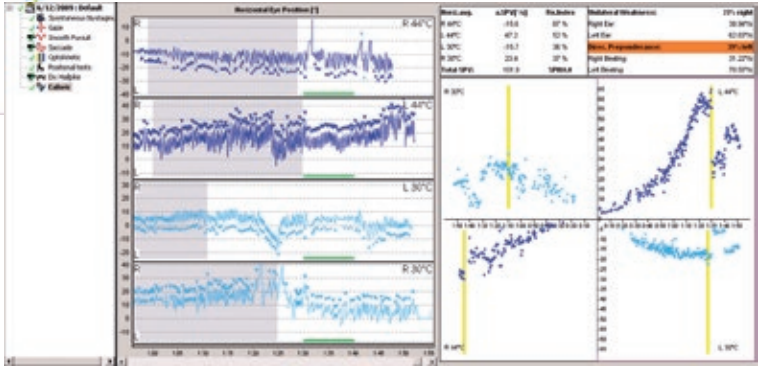


Example of "normal" caloric test results

Caloric Irrigation
- Examples of test results



Example of left unilateral weakness



Example of left directional preponderance

Jacobson GP, Shepard NT. Balance Function Assessment and Management. San Diego; Plural Publishing, 2008.

*NOTE: It is important to remember that it is not within the audiologist's scope of practice to diagnose disease. An audiologist is limited to simply stating whether documented test results indicate a dysfunction of either the central or peripheral vestibular system. Official diagnosis should be deferred to the patient's physician.

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