

What is the VAT?

For most of the population, balance control occurs at an unconscious level. Signals from the inner ear continuously drive the eye muscles to coordinate eye movement with head movement. This coordination is necessary to have clear vision and balance. The communication between the ear and the eye is called the vestibulo-ocular reflex (VOR). When the VOR is functioning properly, eye speed and timing are equal and opposite to those of the head. But, if the speed or timing is off, even slightly, vision is distorted because of apparent motion of the visual field.

The VAT® is an 18-second test (performed six times) of the high frequency horizontal and vertical VOR's for diagnosis, treatment planning and monitoring of vestibular disease. The frequency tested (2 - 6 Hz) closely approximates normal head movements. For example, many patients complain of dizziness or loss of balance when they are walking, bending over or turning their head quickly. The VAT® quickly and comfortably monitors a patient's head and eye motions to record what is happening in the vestibular portion of the inner ear.

Testing with the VAT® often identifies problems not found with other vestibular tests, because the VAT® tests natural, faster motions and unlike other conventional vestibular tests, evaluates both the horizontal and vertical canals. Because the VAT® is sensitive to changes of the VOR and is easy to perform, it is often the first screening test a patient receives who complain of dizziness or balance problems. Patients do not object to repeat testing which makes the VAT® the ideal test to monitor ototoxic medication and vestibular rehabilitation.

The data shown below illustrates the VAT® test results from a gentamicin ototoxicity patient. The normative data is shown as the blue error bars (± 2 std.) Individual patient VAT® data are shown in various colors. Notice that both the horizontal and vertical gains (top two graphs) are well below the normal data. The horizontal and vertical phases (bottom two graphs) are above the normal data. This data pattern is typically seen in gentamicin ototoxicity.

Explanation of Gain and Phase For The VAT®

GAIN: Eye velocity amplitude divided by head velocity amplitude. If you look straight ahead at a spot or target, and move your head to the right, your eyes will move to the left at the same angle and at the same speed.

PHASE: (Latency) A measure of time (in degrees) of the eye velocity relative to the head velocity. As you move your head back and forth your head and eye movements should reach the center at the same time.

Only the last 12 seconds of the test (movements above 2 Hz) are used to compute the gain and phase. This is because above 2 Hz the patient does not use vision to help with balance, therefore relying totally on the vestibular system of the inner ear to maintain balance. This is why VAT testing is done in the light(head movements above 2 Hz) and rotating chair testing is usually done below 2 Hz in the dark(turning off the visual system).

During the first six seconds, the patient moves his head at 1/2 Hz or very slowly. Vision is the dominant system (smooth pursuit system) to maintain balance at these slow motions. This system is controlled by the brain. If a patient cannot fixate on the target while moving his head

back and forth, this suggests a central problem rather than one of the inner ear. This is shown by an irregular tracing of eye velocity that does not match head velocity.

Hz: how fast the patient is moving his head back and forth in a one-second period.

1Hz = 1 complete back and forth motion in one second.

2Hz = 2 complete back and forth motions in one second

3Hz = 3 complete back and forth motions in one second etc.

Description: The VAT complements ENG/VNG caloric findings. ENG/VNG measures head movements at ultra low frequencies (.003 Hz); this degree of movement is not representative of natural head motion (non-physiological). The VAT, on the other hand, is sensitive to higher frequencies of head movement (0.5 Hz to 6.0 Hz) and measures both the horizontal and vertical canals (ENG/VNG only horizontal). As a result, the vestibular system is measured at both low (ENG/VNG) and high (VAT) frequencies, thus providing a much more comprehensive evaluation of the inner ear balance organ.

Total Time to Implement the VAT: 30 minutes for electrode set-up, education to patient on test and testing procedures, three horizontal and three vertical testing, removal of electrodes, education of findings to the patients, and documentation.

Use of VAT with Vestibular Rehabilitation

Test results from the VAT® are used to design a vestibular rehabilitation program that is specific to each patient's needs. For example, if the test results suggest problems in the vertical VOR system, exercises that stimulate activity of the vertical VOR are emphasized. The patient's progress is monitored with repeated VAT® tests during the vestibular rehabilitation program. Typically the test is repeated every 4 weeks during the treatment protocol to compare the baseline VAT® result to the VOR changes occurring during the vestibular rehabilitation program.

The VOR can be recalibrated to allow clearer vision during rapid movement involved in activities of daily living (ADLs). Specific head and eye exercises can accomplish this by triggering changes in how the brain processes movement information. These changes occur naturally in response to aging and changes in vision, but can also be triggered with specific exercise therapy to help patients with balance system disorders.

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