

Morpho-chronological analysis of vHIT traces

PRODUCT INSIGHTS

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This document provides a comprehensive overview of how to perform the video Head Impulse Test, starting from the physiological bases up to daily diagnostic. SYNAPSYS VHIT is a unique system that represents a fundamental step forward in the evaluation of the vestibular system. It does not require the patient to wear any goggles; all results are obtained from the analysis of the patient's head and eye movements, recorded by a remote camera.

General concept

The v-HIT consists of the selective analysis of each of the six semicircular canals through head impulse stimuli realized at high velocity: $\geq 200^\circ/\text{sec}$ for the horizontal canals and $\geq 150^\circ/\text{sec}$ for the vertical ones. Some elements are fundamental for a correct outcome and interpretation of the exam:

1. much like VNG is above all a technique, V-HIT is mainly an art: it expresses itself with the examiner's ability to perform impulsive movements of the head at high velocity.
2. the correct execution of the V-HIT requires a patient who:

- a) keeps his/her eyes open;
 - b) has a neck that's easy to move;
 - c) has the intention to observe the target.
3. The video recordings of each impulse are the objective testimony of what happens, and, in case of doubtful interpretation, it is advisable to have the possibility to watch them again and again (in slow motion).
 4. The "reciprocity principle":
 - in case of reduced gain a corrective (compensatory) saccade brings the eye back to the target (except for some patients with cerebellar pathologies);

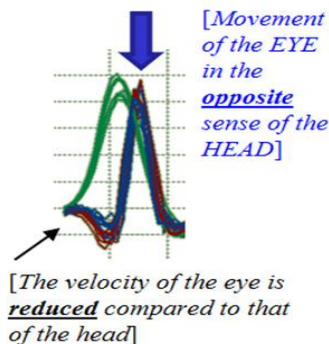


Figure 1 Head-Eye traces in case of reduced VOR gain

- in case of a [true] hypergain, an anti-compensatory saccade must be present to bring the eye back to the target.

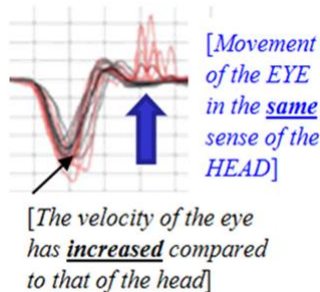


Figure 2 Head-Eye traces in case of increased VOR gain

So, if the gain is reduced or increased but the corrective saccade (both compensatory and anti-compensatory) is absent, then the gain calculation may not have been correctly carried out.

5. The presence of a corrective saccade confirms the pathological state with more certainty than just the reduction or increase of the gain.

Very recent papers in the literature suggest that the presence of repeatable corrective saccades may indicate a VOR deficit, since a repeatable corrective saccade, regardless of the gain value indicates a pathological v-HIT. It is therefore advisable to evaluate both the corrective saccade and the v-HIT gain to catch the vestibular hypofunction.

In the case of hyper-gain, in order to maintain the line of gaze on the target a corrective saccade in the same direction of the impulsive movement of the head will manifest (reversed corrective saccades). Remember that, in the presence of a deficit gain, the corrective saccade will be in the opposite direction of the head movement.

In conclusion, we can state that the v-HIT does not consist of merely calculating the semicircular canals' saccadic gain, but it is above all an opportunity to perform a rigorous morpho-chronological analysis of the VOR and eye movements (saccades) related to it.

The test therefore involves a specific a learning curve.

Initially we will focus on the numerical gain value (normal or pathological) and then on the presence of the saccadic movements (whether present or absent), on the distribution of the impulses' velocity, on the slow-motion videos of impulses (the interpretation of which is unclear), and finally on more specific parameters (high velocity of impulses, decline in gain as the impulses' velocity increases, horizontal dispersion or otherwise of the saccade, vertical dispersion of the gain values as an index of the S/N ratio, presence of Anti-compensatory Quick Eye Movements - AQEM, presence of artifacts and/or anomalies).

In morpho-chronological v-HIT analysis it is necessary to evaluate the morphology of the oculo-motor response and the timing with which both the VOR and the corrective saccades appear, regardless of whether these are overt or covert. This assessment should be carried out both within a single session and where there are multiple examinations scheduled over time. The temporal distribution of covert saccades together with the method of using covert/overt ones have proved to be powerful means to monitor the evolution and the effectiveness of compensation in the case of uni- and bilateral vestibular deficits.

The following series of tests highlights the how a subject, who has undergone chemical labyrinthectomy, uses overt corrective saccades as an oculo-motor strategy before rehabilitation; during the latter both covert and overt occur simultaneously, and at the end of rehabilitation they are exclusively covert (all credits to: Olivier Dumas, Lyon, 2018).

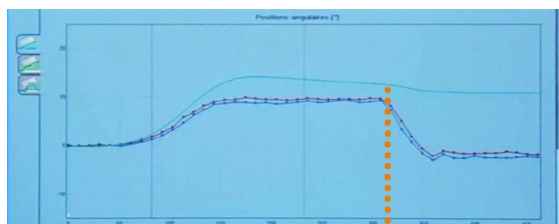


Figure 3 Overt Saccade Dumas O., 2018

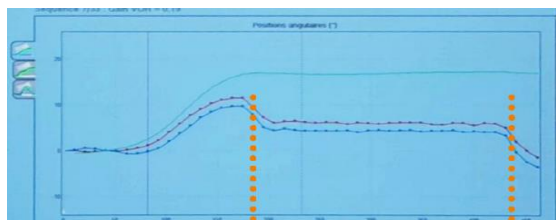


Figure 4 Covert + Overt Saccade. Dumas O., 2018

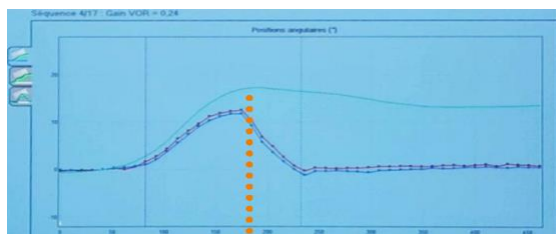


Figure 5 Covert Saccade. Dumas O., 2018

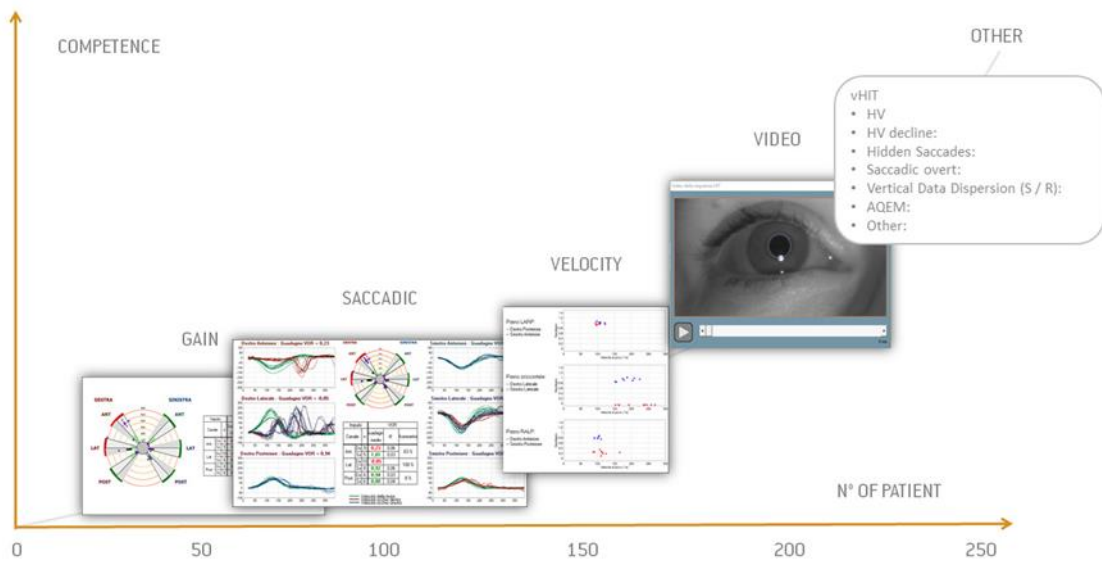


Figure 6 Armato E., 2018



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