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Insights on vHIT from literature

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 diagnostics. 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.

The correct direction of gaze for vertical VOR analysis

In the evaluation of the vertical canals with the v-HIT, the position of the eye orbit, and thus the line of gaze, will lie on the same plane as the pair of stimulated canals. The gaze will be pointing to the left for the left anterior and right posterior canals (with the head rotated to the right) and to the right for the right anterior and left posterior canals (with the head rotated to the left).

The more the line of gaze deviates from the parallelism with the plane of the stimulated canal, the more the calculation of the gain may be distorted. This is due to the reduction of the vertical component and increase of the torsional component of the oculomotor response.

Outward versus inward head impulse

Since the impulsive stimulus can be administered either with a movement that goes from the center to the right or left (outward) or with a forward rotation from the periphery toward the center (inward), the issue of the equivalence of the two maneuvers arises.

It is indifferent whether the stimulus is inward or outward, both in normal and pathological conditions; there are no differences in gain and/or corrective saccadic movements.

Corrective saccades and vestibular compensation

Patients who compensate with a "gathered pattern" saccadic strategy, with covert saccades always with the same latency, will have lower levels of disability and postural instability, compared to those with a "scattered" saccadic strategy.

Refixation saccades in patients with normal VOR gain

The presence of a VOR with normal gain that is associated with refixation saccades occurs more frequently with increasing age and in combination with specific vestibular disorders such as Menière's disease, or after the fitting of a cochlear implant (in this case it may be a merely temporarily response). Refixation saccades may reflect a partial dysfunction of the VOR. The interpretation of this phenomenon conflicts with the current decoding of v-HIT, solely based on the gain value and used to classify the vestibular function (normal or pathological).

Anti-Compensatory Quick Eye Movement (AQEM)

The AQEM is not associated with a VOR gain >1.00 , but with a delayed VOR slow phase deceleration - after the maximum velocity peak. The eye moves at a higher velocity than that of the head, therefore surpassing the target, and at the end of the head movement an anti-compensatory saccade must bring it back.
AQEMs represents a sign of peripheral dysfunction and localize the side of the lesione in patients with and without nystagmus.

Saccadic movements with abnormal direction

In cerebellar pathology both downward (perverted) and paradoxical saccadic movements, i.e., in the direction of head movement, have been described.

Abnormalities in the slow phase, in saccades and artifacts

Artifacts, VOR abnormalities and disturbances in saccadic movements should always be carefully researched.

Asymmetry of gain

Gain asymmetry is similar to relative hypovalence in caloric tests. AI is calculated as

$$GA = \frac{(GL-GR)}{(GL+GR)} \times 100$$

where GA is gain asymmetry, GR is right sided mean gain and GL is left sided mean gain.

Differential diagnosis between compensatory saccades, fast phases pf nystagmus and square wave jerks

Differential diagnostics between compensatory saccades, nystagmus fast phases and square waves are necessary.

Interference of spontaneous nystagmus in the calculation of gain

Spontaneous nystagmus can interfere with the calculation of the gain only if its velocity is greater than 30°/sec.

Slow visual saccades

Selective slowing of saccades to a visual target is a hallmark of some neurological conditions and forms part of their diagnostic criteria, e.g. Progressive Supranuclear Palsy (PSP) and SpinoCerebellar Ataxia type 2 (SCA 2). In a recent study (Yacovino DA, 2018) performed on groups of patients with slow saccades and normal controls, it was shown that saccadic movements produced during the v-HIT are comparable to visually guided saccades.

Awarness of timing and/or direction of movement

In the clinical HIT, lack of predictability in the direction of the impulsive movement has always been considered significant, but a recent paper refuses this assertion.

vHIT with remote camera: applications in childern

Recent paper in the literature highlights interesting applications of v-HIT with remote camera. Remote video recordings and adapted protocols allow the HIT to also be performed in children of three months in less than ten minutes. The values of the VOR gain presented in the paper cited above may be used as reference standards to compare the results in pediatric patients of different ages. While the VOR gain remains relatively constant after the age of sixteen, a rapid increase in gain has been documented up to six years of age, followed by a more moderate development to levels like those seen in adults.

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