Vestibular Function Testing —

Interpretation for Physiotherapists

Reading vHIT, Caloric, and VEMP Reports to Guide Rehabilitation

Vestibular Physiotherapy for Clinicians

Topic 11 of 12

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How to Use This Review

This literature review equips physiotherapists with a special interest in vestibular rehabilitation with the practical skills to read, interpret, and clinically apply vestibular function test (VFT) reports. Each major test is explained in terms of physiology, the numbers that matter for rehabilitation, and the prescribed exercise change a given pattern of results should trigger.

The document follows a structured clinical format with numbered sections, integrated callout boxes for rapid reference, summary tables, four embedded flowcharts and a complete reference list. It is designed as a working desk reference for the physiotherapist who receives a VFT report and needs to translate it into individualised rehabilitation in a single appointment.

Key Point: VFT reports are not pass/fail — every numeric pattern (gain, asymmetry, threshold) maps to a specific rehabilitation lever. Reading the report well halves wasted exercise time.

Clinical Insight: Most physiotherapists never received structured training in interpreting vHIT, caloric, rotational chair, or VEMP tracings — closing this gap is the single highest-yield CPD investment for the vestibular physio.

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I. Introduction: Why Physiotherapists Need VFT Literacy

Vestibular function testing (VFT) provides objective, quantifiable measurement of peripheral vestibular function — semicircular canal sensitivity (vHIT, caloric, rotational chair), otolith integrity (cVEMP and oVEMP), and the central interpretation of those signals (subjective visual vertical, smooth pursuit, saccades). Unlike most musculoskeletal physiotherapy, vestibular rehabilitation hinges on a battery of tests interpreted together; the rehab prescription that follows depends directly on the side, magnitude, and end-organ of the deficit [1,2].

The physiotherapist who can read a vHIT report and a VEMP tracing knows whether to prescribe gaze stabilisation, substitution, or otolith-targeted balance work. The physiotherapist who cannot read those tracings prescribes a generic program and accepts a much lower success rate. Reading the numbers replaces guesswork with mechanism-targeted dosing.

Key Point: Three numbers drive rehab decisions: vHIT VOR gain (less than 0.8 = canal hypofunction), caloric canal paresis (over 25%), and VEMP asymmetry (over 35–50% = otolith asymmetry).

Figure 1. VFT Three-Vertex Map

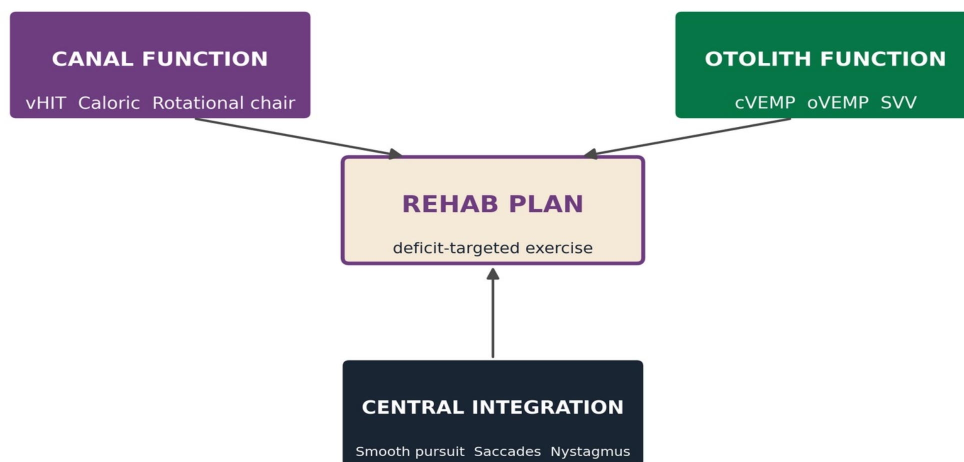

Figure 1. VFT three-vertex map — canal, otolith, central — converges on the rehab plan.

Source: Australian Dizziness Clinics, 2026.

II. Video Head Impulse Test (vHIT)

VOR Gain and Catch-up Saccades

The vHIT measures vestibulo-ocular reflex (VOR) gain during rapid, unpredictable, low-amplitude head impulses (10–20°, 150–300°/s peak velocity). Each lateral, anterior, and posterior canal is tested

individually. Normal VOR gain is 0.8 to 1.0; values below 0.8 indicate canal hypofunction. The system also detects catch-up saccades — covert saccades (during head movement) and overt saccades (after head movement). Refixation saccades are the bedside fingerprint of peripheral hypofunction even when gain is borderline [3,4].

Clinical Pearl: For rehabilitation: low VOR gain plus refixation saccades = clear indication for VOR x1 / x2 gaze-stabilisation training. Train at the affected canal's plane (lateral plane head turns for lateral-canal hypofunction; pitch plane for anterior/posterior).

Canal-Specific Deficits and Lateralisation

Unilateral lateral-canal hypofunction is typical of vestibular neuritis (superior division usually involved — affects lateral and anterior canals) and recovery from BPPV. Bilateral lateral-canal weakness suggests central or bilateral peripheral pathology (ototoxicity, autoimmune labyrinthitis, sequential neuritis) and changes the rehab approach entirely from adaptation to substitution. Posterior-canal-only hypofunction is rare and raises concern for inferior vestibular nerve branch involvement [3].

Clinical Insight: If only the affected lateral canal is hypofunctional and posterior canal is preserved, the patient is typical post-superior-vestibular-neuritis — adaptation-focused VRT will work well. If all three canals are hypofunctional, prepare for a slower, substitution-heavy program.

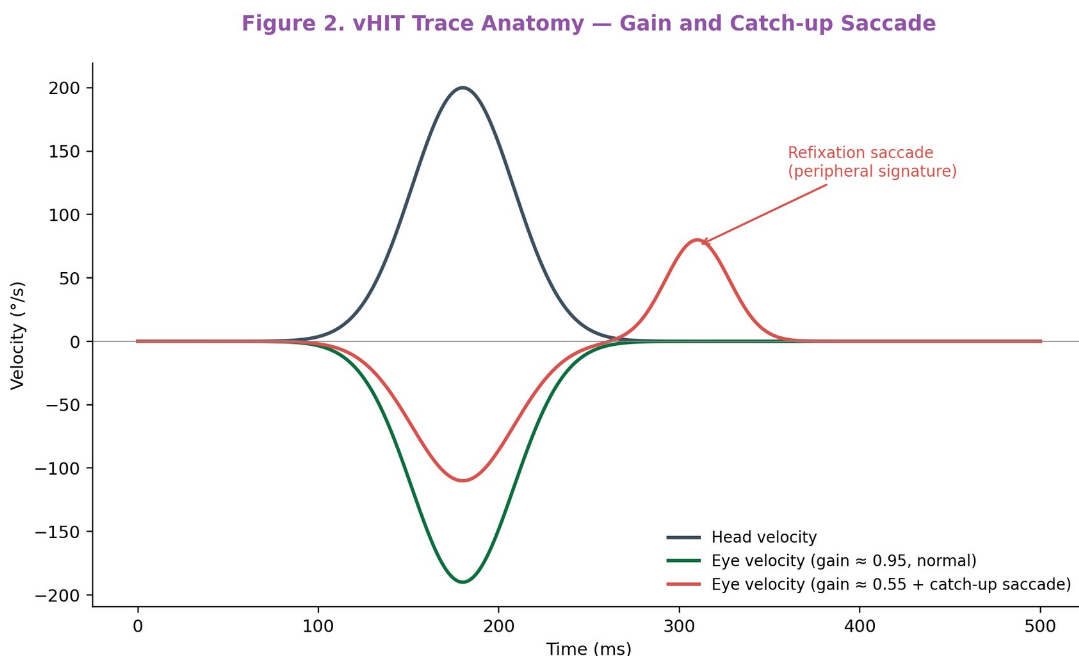

Figure 2. vHIT trace anatomy — VOR gain and the catch-up saccade signature.

Source: Australian Dizziness Clinics, 2026.

III. Caloric Testing

Canal Paresis and Directional Preponderance

Bithermal caloric testing (warm 44°C and cool 30°C irrigation in each ear) provokes lateral canal-only stimulation at low frequency (0.003 Hz). The Jongkees formula calculates canal paresis (CP) — lateralised weakness — and directional preponderance (DP) — asymmetric biased nystagmus. CP

greater than 25% indicates significant lateral canal asymmetry; DP greater than 25% without CP suggests a central or compensatory bias [5].

The caloric is a low-frequency probe that complements the high-frequency vHIT. A patient may have a normal vHIT but abnormal calorics (low-frequency hypofunction with preserved high-frequency adaptation) — common in early compensated peripheral lesions — or vice versa, in chronic vestibulopathy with high-frequency loss but preserved low-frequency function. Interpret vHIT and caloric as a frequency-pair, not as duplicates.

Bilateral Weakness — A Rehabilitation Game-Changer

Bilateral caloric weakness (<25 °/sec total response across both ears) signals bilateral vestibulopathy and demands a dramatic rehabilitation shift: away from gaze-stabilisation adaptation toward substitution strategies (cervico-ocular reflex training, anticipatory saccades, proprioceptive cueing) and balance retraining under varied sensory contexts [10]. The risk of falls is materially higher; visual and proprioceptive substitution becomes the patient's primary balance system.

Important: Bilateral caloric weakness combined with reduced vHIT gain bilaterally is the diagnostic signature of bilateral vestibulopathy. Avoid eyes-closed standing on foam without supervision — fall risk is high. Prescribe substitution-based VRT and gait aid review.

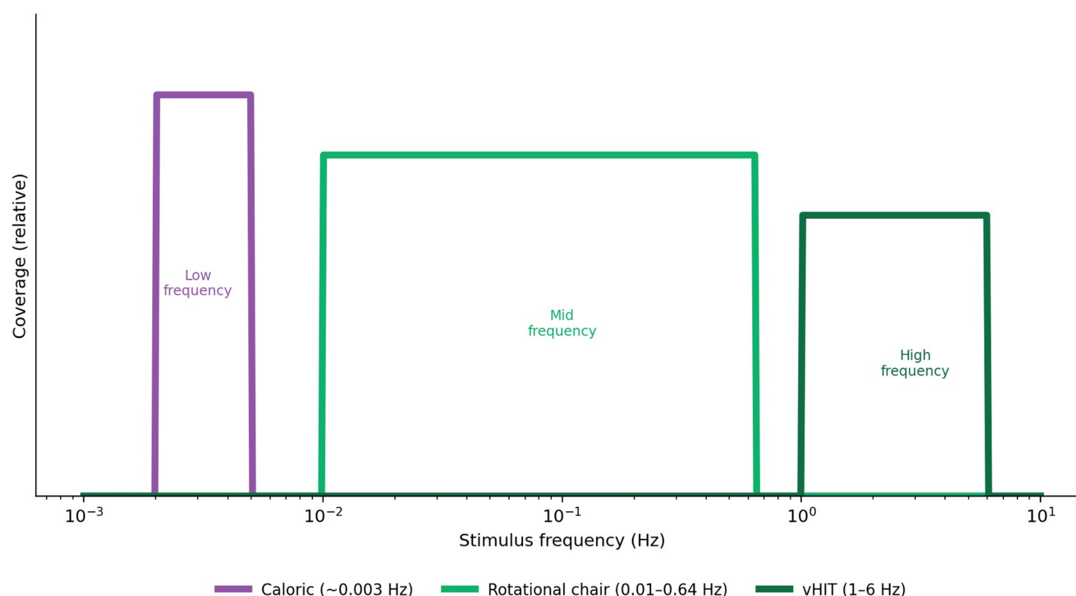

Figure 3. Caloric, rotational chair, and vHIT cover complementary frequency bands.

Source: Australian Dizziness Clinics, 2026.

IV. Rotational Chair Testing

Rotational chair assesses lateral-canal VOR gain and phase across multiple frequencies (commonly 0.01 to 0.64 Hz), filling the frequency band between calorics (very low) and vHIT (very high). Normal VOR gain is 0.8 to 1.0 across frequencies; reduced gain and abnormal phase lead suggest bilateral peripheral hypofunction [6]. The chair is more sensitive than calorics for detecting bilateral loss and for monitoring serial change.

Gain symmetry across left and right rotation also helps lateralise unilateral lesions in chronic, well-compensated patients in whom bedside head impulse and clinical examination have normalised. For

rehabilitation, an abnormal rotational chair with preserved vHIT is the patient who needs frequency-broadened VOR adaptation training (1–2 Hz and 4–6 Hz both prescribed).

Clinical Pearl: Match exercise frequency to deficit frequency. Low-frequency loss on rotation responds to slower head turns (1–2 Hz x1 / x2); high-frequency loss on vHIT responds to fast head turns (4–6 Hz x1 / x2). Frequency-specific dosing beats generic prescription.

V. VEMP Testing — Otolith Organ Assessment

cVEMP — Saccular Function

Cervical VEMP (cVEMP) measures the response of the inferior vestibular nerve and saccule to high-intensity auditory stimulus, recorded from the ipsilateral sternocleidomastoid muscle. P13–N23 latencies and asymmetry ratio over 35% indicate saccular hypofunction or absent response [7]. Saccular dysfunction contributes to head-tilt symptoms, asymmetric otolith input, and atypical balance presentations.

oVEMP — Utricular Function

Ocular VEMP (oVEMP) measures the contralateral inferior oblique response to vibration or sound, reflecting utricular and superior vestibular nerve integrity. n10–p15 latencies and asymmetry ratio over 35% indicate utricular dysfunction [7]. Utricular asymmetry is strongly associated with subjective visual vertical tilt, ocular tilt reaction, and persistent lateropulsion symptoms.

For physiotherapists, the practical message is that an absent cVEMP or oVEMP changes the deficit profile from a pure canal lesion to a mixed canal-otolith lesion — these patients benefit from otolith-targeted balance work (head-tilt control with and without visual reference, dynamic head-on-trunk activities) on top of standard gaze-stabilisation drills.

Clinical Insight: VEMP asymmetry over 35–50% on the affected side is the classic pattern in superior canal dehiscence, vestibular neuritis involving the inferior division, and utricular contributions to lateropulsion in lateral medullary syndrome. Each requires a different rehab emphasis.

Figure 5. VEMP Pathways — Saccule and Utricle

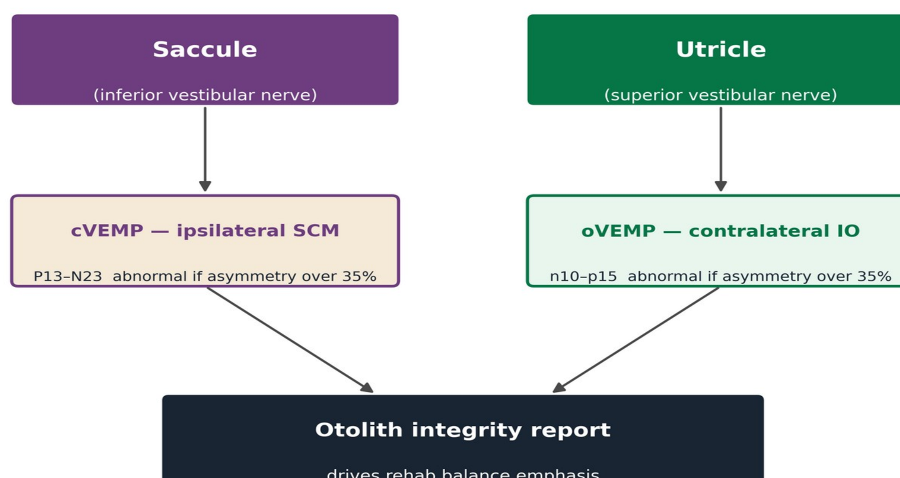

Figure 5. VEMP pathways — cVEMP (saccule/inferior vest n) and oVEMP (utricle/superior vest n).

Source: Australian Dizziness Clinics, 2026.

VI. Subjective Visual Vertical and Audiometry

Subjective visual vertical (SVV) testing provides a fast, inexpensive measure of utricular function. Patients align a tilted rod to true vertical in the dark; deviations greater than 2.5° from true vertical indicate utricular asymmetry. SVV is complementary to oVEMP and tracks recovery during rehabilitation [8].

Audiometry is included in every comprehensive vestibular work-up. Asymmetric sensorineural hearing loss raises concern for vestibular schwannoma; low-frequency fluctuating loss suggests Ménière's disease; sudden hearing loss with vertigo is labyrinthitis until proven otherwise. Hearing data does not directly drive physiotherapy prescription, but it tightens the diagnosis the rehabilitation is built on.

VII. Integrating Multiple Tests into the Rehab Plan

No single VFT defines the full deficit. The rehab-relevant integration looks at three vertices: canal function (vHIT, caloric, rotational chair), otolith function (cVEMP, oVEMP, SVV), and central function (smooth pursuit, saccades, head-shaking nystagmus, rotation). Each combination triggers a specific exercise emphasis [1,2,9]:

Pattern	Test signature	Rehab emphasis
Acute UVH — superior division	vHIT lateral+anterior loss; caloric CP; otoliths spared	Adaptation: VOR x1/x2 affected plane; early gait
Acute UVH — full division	vHIT all canals; caloric CP; cVEMP+oVEMP asymmetry	Adaptation + otolith balance work; longer course
Bilateral vestibulopathy	vHIT bilateral loss; caloric bilateral weakness	Substitution: COR, anticipatory saccades, proprioception
Vestibular migraine	VFTs often normal or mild non-specific	Habituation; pacing; trigger management
PPPD	VFTs normal; symptoms persistent post-trigger	Habituation + CBT; visual desensitisation
Chronic compensated UVH	vHIT abnormal but symptoms minimal	Maintenance; no escalation needed

Physiotherapist takeaway: read the report as a vertex map (canal/otolith/central), then prescribe to the dominant deficit.

Key Point: Always look at all three vertices — canal, otolith, central. Missing the otolith arm is the single commonest reason a VRT program plateaus when the patient still has lateropulsion or head-tilt symptoms.

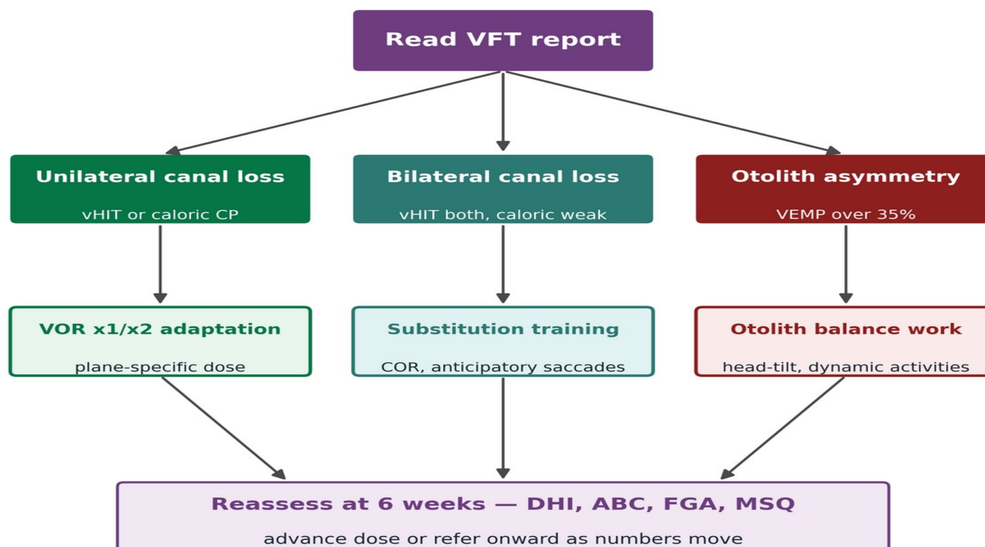

Figure 4. From VFT pattern to rehab decision tree — three deficit signatures, three exercise emphases.

Source: Australian Dizziness Clinics, 2026.

VIII. Case Examples

Case 1 — Right superior division vestibular neuritis

A 48-year-old presents two weeks after acute vertigo. vHIT shows right lateral canal gain 0.55, right anterior canal gain 0.6, left canals 0.95. Caloric: right CP 48%. cVEMP and oVEMP symmetric. Audiometry normal. SVV +1.5° rightward. The deficit is a right superior division neuritis with spared otoliths. Prescribe right-affected-plane VOR x1 / x2 gaze stabilisation, daily balance progression, and brief habituation for residual visual vertigo. Expect functional recovery in four to six weeks.

Case 2 — Bilateral vestibulopathy from gentamicin

A 64-year-old after a course of intravenous gentamicin presents with oscillopsia and unsteadiness on uneven ground. vHIT shows bilateral lateral-canal gains 0.4, bilateral anterior 0.5. Caloric: total response 18°/sec (markedly reduced). cVEMP absent bilaterally. The deficit is bilateral peripheral vestibulopathy with bilateral otolith involvement. Adaptation will not work — prescribe substitution-based VRT (cervico-ocular reflex, anticipatory saccades), graded balance under sensory variation, and a gait aid review. Expect a longer rehabilitation course with attention to falls risk.

IX. Conclusions and Practical Workflow

Reading VFT reports is a learnable, high-yield clinical skill. The practical workflow is: (1) check vHIT gain and saccades on all six canals and identify hypofunctional planes; (2) read caloric CP and DP; (3) review cVEMP and oVEMP for otolith integrity; (4) check rotational chair phase and gain across frequencies if available; (5) cross-check with SVV and audiometry; (6) map the pattern to one of the recognisable rehab phenotypes in the table above; (7) write the exercise prescription targeting the dominant deficit at the correct frequency.

This approach turns a six-page VFT report into a one-page rehabilitation plan in under fifteen minutes. The investment in interpretive skill is recovered many times over in the first month of practice through better-targeted prescription and faster patient progress.

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Every effort has been made to ensure accuracy and completeness at the time of publication; however, the field of vestibular medicine evolves rapidly. Readers should consult current guidelines and primary literature when making clinical decisions.

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