

## *Differentiating Functional Impairments*

### BPPV With Disequilibrium

A 70 year-old librarian assistant was referred to an ENT by his primary care physician. He complains of positional vertigo, confirmed on clinical examination as BPPV or canalithiasis of the right posterior semicircular canal. He underwent a canalith repositioning procedure (CRP) that day.

He returns one week later to his primary care physician with resolution of the positional symptoms, but continued complaints of fleeting dizziness. He also complains of imbalance, impairing his ability to work safely, particularly in the higher book stacks. The office examination results were as follows:

- **Past medical history:** Non-contributory
- **Previous work-up:** None
- **Clinical examination:** Repeat vestibular clinical exam and Dix-Hallpike were negative



- **Test results:** None to date

**Impression:** The patient is medically stable with resolution of the BPPV. However, there remains a complaint of balance abnormality and visual symptoms. This is suggestive of residual vestibular system impairment.

The medical finding of BPPV alone is insufficient to identify why the patient is failing to compensate. Also, medical findings do not provide direction for an appropriate treatment plan.

For the primary care physician to answer these questions and to design an effective treatment plan the following new information is needed:

1. Is there residual vestibular system impairment? Should there be a referral for ENG?
  - a. What is the state of vestibular compensation following resolution of the mechanical problem (BPPV)?
  - b. Is there a residual, plane-specific impairment of vestibular dysfunction?
2. Are there secondary impairments of balance function, such as related to age?
3. Given the visual complaints, is there an associated impairment in the gaze control system?
4. What treatment approach will achieve resolution?

To answer questions regarding the vestibular and balance systems, the patient was simultaneously referred back to the ENT physician for ENG testing and to physical therapy for Computerized Dynamic Posturography (CDP) as well as Dynamic Visual Acuity (DVA) testing.

Objective impairment assessments provided objective information identifying the problem and differentiating it from the aging process.

#### Inside You'll Find ...

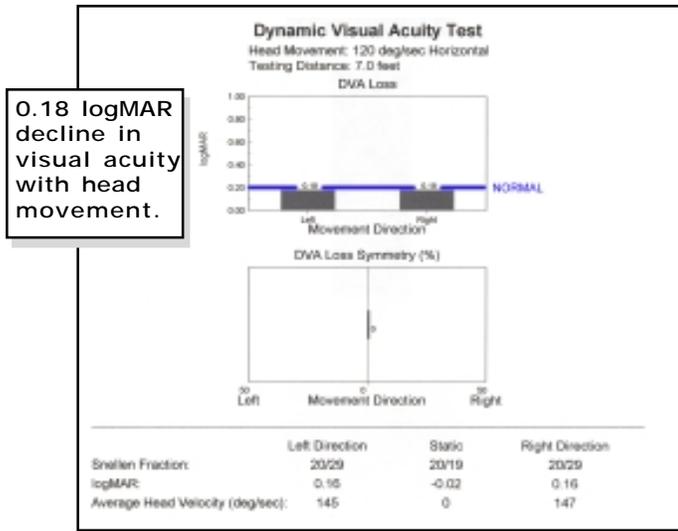
- Post-treatment objective evidence that the patient will keep gainful employment.
- Multi-disciplinary approach to identify the problem and differentiate sensory and motor system impairments.



## Measuring Impairment

To isolate and quantify impairments related to the patient’s complaints of both visual symptoms and imbalance, the functions of the gaze and balance control systems are examined. The patient was also referred for ENG to investigate the possibility of additional vestibular system pathology.

**Gaze Control:** The Dynamic Visual Acuity (DVA) test provides a measure of a patient’s ability to accurately view objects during head movement and is an indirect measure of the compensation of the Vestibular Ocular Reflex (VOR). Test results provide information about the direction and velocity of head movements resulting in decreased gaze stability.



0.18 logMAR decline in visual acuity with head movement.

DVA results identify a 0.18 LogMAR decline in visual acuity during head movement in the horizontal plane. This is essentially normal performance, thus indicating the absence of a gaze control problem (and indirectly a VOR problem).

FIGURE 1 (pre-treatment): Normal dynamic visual acuity test.

**Balance Control:** Balance control was tested using Computerized Dynamic Posturography (CDP). CDP isolates and quantifies impairments related to the effective use of sensory inputs and motor responses.

The Sensory Organization Test (SOT) identifies abnormalities in the patient’s use of the three sensory systems: somatosensory, visual, and vestibular. The patient was symptomatic and performance was inconsistent on the SOT conditions 5 and 6 (Figure 2) and he was symptomatic under conditions of vestibular demand (5, 6). These results are suggestive of vestibular impairment.

The Motor Control Test (MCT) assesses the ability of the automatic motor system to quickly recover following an unexpected external disturbance. Results of the MCT (Figure 3) were within age-matched normative performance ranges. The Adaptation Test (ADT) assesses a patient’s ability to minimize sway when exposed to surface irregularities and unexpected changes in support surface inclination. Results of the ADT (Figure 4) were within normal ranges. These results indicate an absence of motor control problems associated with aging.

Functional balance was quantified using the Dynamic Gait Index (DGI), a clinical measure of functional performance during eight typical mobility tasks. The patient receives a performance “score” that correlates with risk to fall and individual performance deficits can guide setting of functional rehabilitation goals.



## Sensory Integration

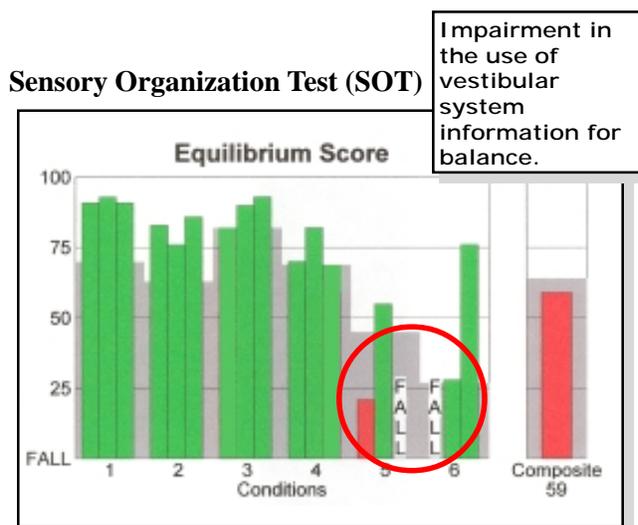


FIGURE 2 (pre-treatment): Inconsistent SOT performance on the vestibular conditions 5 and 6 identify a sensory balance problem.

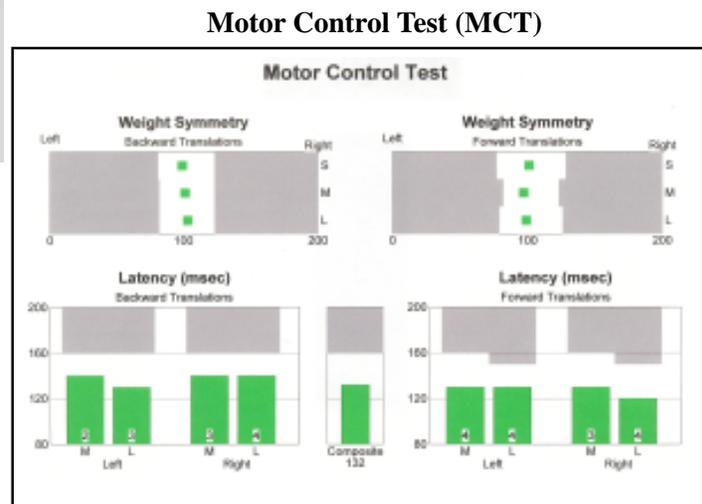


FIGURE 3 (pre-treatment): Normal automatic motor response latencies.

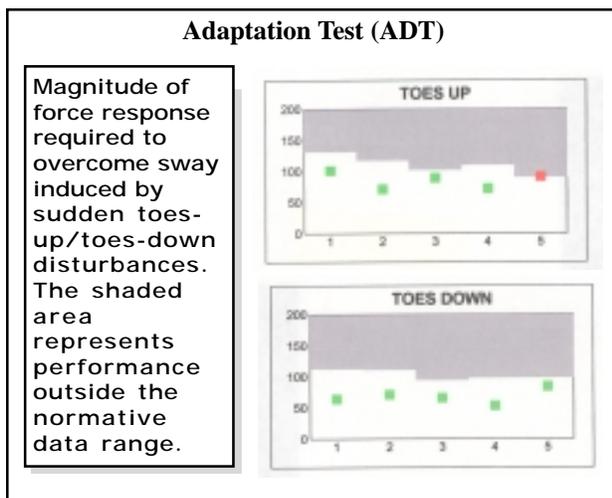


FIGURE 4 (pre-treatment): Normal adaptive motor response to a sudden, unpredictable surface.

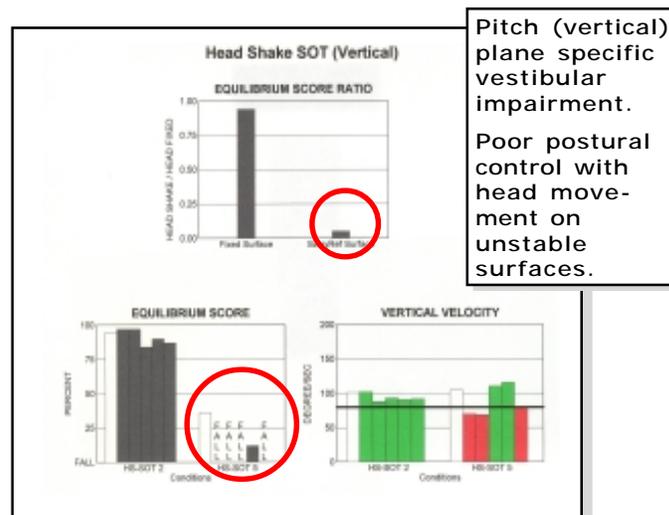


FIGURE 5 (pre-treatment): Abnormal HS-SOT (Head Shake-SOT) performance = plane specific test of vestibular function.

Because SOT results were suggestive of vestibular impairment, the Head Shake-SOT (HS-SOT) (Figure 5) was selected to increase balance demand using head movement. Assessment was performed in specific planes of movement such as might be required for this patient's occupation. Test results revealed significant vestibular impairment with pitch plane head movement, which is consistent with poor vestibular compensation.

In terms of functional performance, the patient scored a 20/24 on the DGI, indicating no risk to fall. Predictably, he demonstrated difficulty on components involving rapid turns and head movement during gait.

In summary, test results confirm the problem as specific to vestibular function for balance. The test results did not confirm significant involvement of other peripheral or central systems, nor did they suggest effects of aging as having a significant role.



## Impression & Recommendation

The ENG test revealed a 15% asymmetry, with weaker response from the right side. This degree of asymmetry is generally considered to be within the normal range. The CDP and DVA impairment tests helped to determine that the patient has difficulty using vestibular cues on demand, particularly in the pitch plane of head movement as identified by impairments from the SOT conditions 5, 6 and the HS-SOT. These impairments relate to his chief complaint of symptoms while working as a librarian assistant. The MCT, ADT, and DVA subtests showed that there is no associated motor control or gaze stability problems contributing to his dizziness.

How did the impairment information contribute to the appropriate treatment plan?

The office examination results were as follows:

- **Past medical history:** Non-contributory
- **Previous work-up:** None
- **Clinical examination:** Repeat vestibular clinical exam and Dix-Hallpike were negative
- **Test results:** First office exam resulted in no tests. However, a simultaneous referral for ENG was ordered along with CDP and DVA testing.

Additional information from the CDP protocols, as well as motor coordination tests, identified the key impairments:

- SOT and HS-SOT demonstrated balance deficits under dynamic conditions.
  - Confirmed incomplete vestibular compensation
  - Identified specific vertical plane impairments in balance control

Caloric ENG responses with relatively small asymmetries present a familiar clinical dilemma. Small asymmetries are usually considered within test error, but may also suggest a mild vestibular lesion. In this case, the HS-SOT findings demonstrated that although small, the vestibular asymmetry revealed by ENG was uncompensated and was having a significant functional impact on the patient’s ability to perform at work. HS-SOT findings clearly outlined the need and appropriateness of a rehabilitation referral. Recommendation was narrowed to vestibular rehabilitation for the identified impairments.

## Treatment Plan

Objective data provided the path of the treatment plan which includes patient education and rehabilitation along with a home exercise program. The program was narrowed to include balance exercises of head movements performed in specific planes (pitch) with absent vision while on unstable surfaces.

Physical therapy evaluation identified no additional impairments, such as in strength, range, or fitness. The Dynamic Gait Index (DGI), a measure of balance function, was 20/24 or no risk to fall.

### Impairment: Balance Stability

Tests: Sensory Organization Test (SOT)  
HS-SOT

Findings: Sensory balance problem characterized by difficulty using vestibular cues on demand, particularly in the pitch plane. Good prognosis for improvement.

With his fears allayed and a clear understanding of his deficits, the patient remained gainfully employed with modifications of work duties during this time. The prognosis was good for complete vestibular compensation and return to full, safe occupational duty without symptoms.

# Overview

Physical Exam/History



Vertigo with successful canalith repositioning  
• Residual disequilibrium • Dizziness

Diagnostic Hypotheses



1. BPPV - *unresolved* ? 2. Unilateral Vestibular Lesion  
3. Uncompensated, Plane-Specific Vestibular Problem  
4. Aging Changes

Medical Work-Up



Diagnostic Testing  
*ENG (-)*

Blood Pressure  
*NL*

Medical Work-Up  
*NL*

Observational Tests  
• Romberg • Gait  
*WNL*

Diagnosis



**Pathology:** ENG results indicate 15% caloric asymmetry

**Function:** Aging systems - vestibular hypofunction? Unilateral Vestibular problem?

1. Rehabilitation?
2. Watch & Wait?
3. Retirement?

Impairment Work-Up



Tests of Postural and Gaze Control to isolate impairments

Dynamic Visual Acuity (Figure 1)

*Computerized Dynamic Posturography*

Sensory Organization Test (SOT), Motor Control Test (MCT)  
Head Shake-SOT (Figure 3-6)

Impairment Diagnosis



Pitch plane specific vestibular impairment.  
Inadequate for current job duties.

Functional Outcome



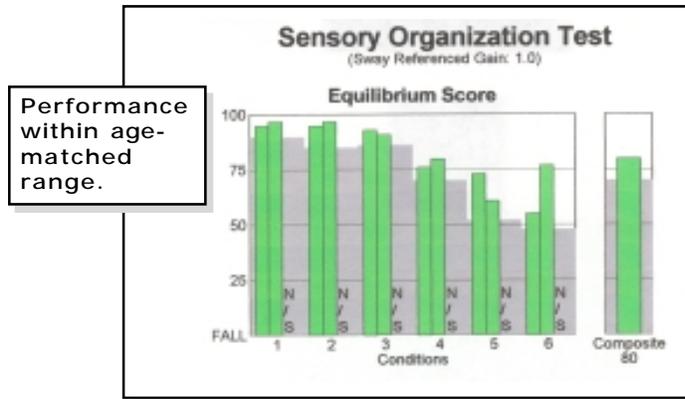
- Re-evaluation confirmed normal performance on all tests.
- Objective data supported clinical decisions regarding functional compensation and continuation of lifestyle.

## Influence of CDP/computerized tests on medical decision-making?

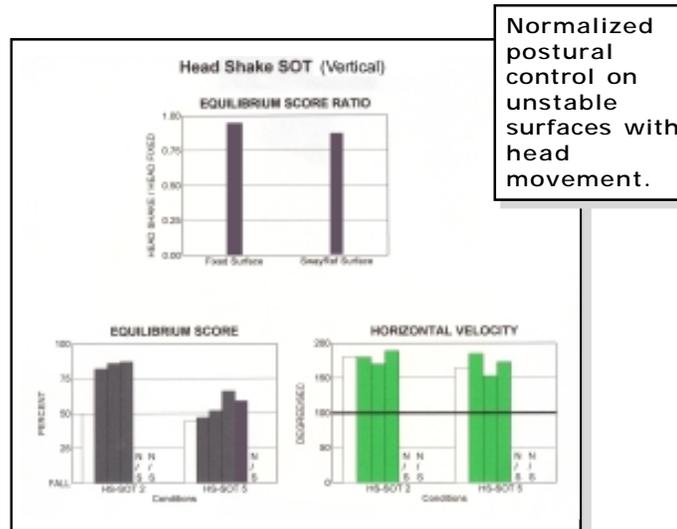
1. CDP showed that the patient's vestibular compensation was inadequate for his current job duties and confirmed no other contributing problems.
2. CDP directed the management approach in general and the vestibular rehabilitation approach specifically.
3. CDP provided an objective benchmark to document the patient's improvement in therapy.

## Functional Outcome

Patient progress was re-evaluated against baseline performance after thirty (30) days of intervention. Patient was asymptomatic and performance on all tests was within normative ranges (HS-SOT, SOT) which indicated functional compensation of the plane specific to the vestibular impairment.



Post treatment: Normal sensory balance.



Post treatment: Normal pitch plane vestibular function.

## The addition of CDP/computerized testing of the status of vestibular compensation provided:

- Objective evidence supporting patient's complaints and symptoms
- Identification of an uncompensated vestibular problem (the combination of caloric and HS-SOT findings)
- Direction for treatment
- Post-treatment objective evidence that patient was ready to return to work

In this case example, the HS-SOT test protocol provided the objective information necessary to guide medical management and rehabilitation. The caloric asymmetry, though clinically equivocal, became functionally significant based upon the HS-SOT.