Conclusions

Although the CTSIB does not specify the exact nature of a subject's balance problem, it is useful in differentiating between individuals with and without vestibular disorders. The test is also useful for obtaining data about patients' performance before and after therapy, and thus in documenting the efficacy of treatment, for the benefit of third-party payers. Because the CTSIB is inexpensive, it is a useful option for clinics in which expensive dynamic posturography testing equipment is unavailable, but where the therapists still need objective data about balance.

Acknowledgments

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References

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Commentary

The development of effective methods for assessing and treating adults with vestibular deficits is a prominent issue for physical therapists and occupational therapists involved with "vestibular rehabilitation." The article by Cohen et al provides a vehicle for the kind of dialogue that is needed about this important topic. I would consider their study preliminary, however, in view of several issues related to the broad generalization of their results, the inconsistency of age-matched comparisons, the recommendation to delete various aspects of the Clinical Test of Sensory Interaction on Balance (CTSIB), and the absence of a documented relationship between stance duration and functional status in patients with vestibular impairments.

Generalization of Findings

The primary conclusion reported by Cohen and colleagues was that the CTSIB "... is useful in differentiating between individuals with and without vestibular disorders." I believe that this conclusion is potentially misleading for several reasons:

1. Subjects with and without active vertigo have equivalent scores on tests of sensory interaction acquired with posturography. The conditions used for evaluating balance with posturography and the CTSIB are essentially the same. Posturography, however, incorporates a force platform and a visual enclosure that can be referenced to spontaneous displacements of the subject's center of force. Posturography provides a more sensitive measure of balance compared with the CTSIB because manipulation of the sensory environment is precisely controlled and equilibrium scores are derived from vertical floor reaction forces. It is unlikely, therefore, that the CTSIB will identify sensory integration deficits in many patients with vertigo, because more sensitive measures do not detect deficits related to this symptom.
2. Subjects with compensated (chronic) unilateral peripheral vestibular impairments often have normal balance responses when tested...
with a neutral head position during posturography. The sensitivity of posturography for identifying abnormalities related to chronic vestibular lesions appears to be increased when patients are positioned with their head tilted contralateral to the side of the lesion. The protocol described by Cohen et al did not include variations in head position. The CTSIB, therefore, may fail to identify many patients with compensated unilateral vestibular impairment, partly because head position was not varied during the test procedure.

3. Sensory integration deficits in patients with vestibular impairment of idiopathic origin (VIIO) often cannot be distinguished from balance responses in healthy subjects. Cohen and colleagues included subjects with vestibular deficits of unknown origin together with those who had localized vestibular lesions (group 4). This procedure could mask the normal balance response associated with VIIO in some conditions, because stance times were averaged for the entire patient group. When the CTSIB is applied in the field to a given patient with a vestibular deficit of undetermined origin, I would not expect this test to consistently identify sensory integration deficits.

These three examples illustrate that the sensitivity of the CTSIB may be dependent on the diagnosis and the patient’s particular symptoms. Combining the types of patients described in the examples above with those who have localized vestibular lesions or acute vestibular deficits might conceal abnormalities that are typically not detectable using the CTSIB. The point is that the authors’ conclusion might have been inappropriately generalized to all patients with vestibular impairment because “vestibular disorders” were treated as a single entity.

### Inconsistencies in Age-Matched Comparisons

The use of “aged-matched” comparisons between healthy subjects and those with vestibular disorders was not consistently applied throughout the study. Postural instability is known to increase with advancing age beyond the second decade of life. Therefore, when measuring balance across groups that are not equivalent with respect to age, groups with younger subjects would be expected to have longer stance times, whereas groups with older subjects would be expected to have lower stance durations. The comparisons of stance duration between the patient group and the remaining three groups of healthy subjects (Fig. 2 in the article) were not corrected for age differences. Based on the analysis associated with Figure 2, the authors assert that (1) subjects with vestibular disorders (group 4) did not perform as well in condition 4 (stance on foam with eyes open) compared with healthy subjects (group 3), and (2) “the vestibularly impaired group performed at the same level as the older AS [asymptomatic] group, regardless of age” in condition 5 (stance on foam with eyes closed).

These assertions directly contradict the “age-matched” results reported by the authors in Figure 3. Specifically, the subjects with vestibular disorders showed equivalent stance duration compared with age-matched healthy subjects in condition 4 and were found to have lower stance duration compared with the age-matched healthy subjects in condition 5.

### Deletion of Stance Conditions

I would urge some caution in following the authors’ recommendation to delete conditions 1 through 3 (quiet standing on a fixed, noncompliant surface with eyes open, eyes closed, and wearing a visual-conflict dome). This recommendation was based on the finding that subjects with vestibular disorders had normal stance times when tested in these conditions. Specific diagnostic groups were not studied by Cohen and colleagues, and the laterality or symmetry of vestibular deficits was not reported. Their results do not agree with the findings of previous studies that did focus on specific vestibular deficits. Black and Nashner showed that patients with “pure” benign paroxysmal positional nystagmus had significant abnormalities in condition 3 (stance on a fixed surface with sway-referenced vision). Norre and Forrez used information from several test conditions including conditions 1 and 2 (stance on a fixed surface with eyes open and eyes closed) to classify the extent of abnormal sensory interaction on balance in patients with Ménière’s disease and paroxysmal positional vertigo. Kantner et al found that patients with peripheral or central vestibular deficits had greater instability in conditions 1 through 3 compared with healthy subjects. Clinical tests of balance that include conditions with eyes open, eyes closed, and visual stabilization during stance on a fixed and compliant surface, therefore, provide more complete information about the underlying cause of balance dysfunction than do tests with these sensory conditions deleted.

### Functional Significance of the CTSIB

The authors suggested that the CTSIB could be used for “documenting the efficacy of treatment ...” In order to support this claim, I believe that the relationship between stance duration and some measure of functional status should have been reported. The relevance of stance time as a functional outcome measure for patients with vestibular impairment has not been established in the context of the CTSIB. Stance time is directly correlated with functional status in healthy elders and with functional level following stroke. Single-leg stance time has been used as one index to measure the effectiveness of vestibular rehabilitation, but this procedure did not involve visual stabilization or stance on a compliant surface. The outcome measure used by Cohen and colleagues requires further study in
order to understand the functional significance of the CTSIB when used with subjects who have vestibular deficiencies. It is my hope that their article will serve as a stimulus for additional clinical research to address this issue.

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We appreciate Dr Di Fabio's comments on our study of the Clinical Test of Sensory Interaction and Balance (CTSIB). We agree that this study was a preliminary examination of the issues related to this test. We did not intend to address the relationship between stance duration and functional status. We intended only to study the issue of timed performance in older asymptomatic adults and vestibularly impaired adults. We were pleased that our study has stimulated some discussion, and we hope that it will stimulate further research.

We agree that computerized, well-controlled posturography may be more sensitive and more accurate than the CTSIB. Many physical therapists, however, do not have sufficient funds in their budgets to buy such expensive test apparatuses. Because of the minimal expense in obtaining the materials for this test, we believe it is more accessible for physical therapists in small clinics, or in clinical environments in which posturography is not practical, such as home health care.

Therapists in these practice settings have the same needs for valid and reliable tests of balance as therapists in major medical centers or university settings. For these practitioners, the CTSIB is a good alternative test.

Di Fabio's comments about the generalizability of our findings are interesting, but we disagree about the meaning of at least one of his citations. He cited a reference that shows "subjects with and without active vertigo have equivalent scores on tests of sensory interaction acquired with posturography" and suggests that this finding implies that neither posturography nor the CTSIB can be used to distinguish between patients with and without vestibular disorders. In spite of the possibility that posturography alone may not show these differences, electromyographic studies demonstrated that patients with peripheral vestibular deficits showed response amplitudes that were significantly less than those of "normal" individuals and were correlated with extent of clinical vestibular deficit.1 These findings suggest that individuals with vestibular disorders may indeed demonstrate shorter stance times on the CTSIB than "normal" individuals.

Our protocol involved no changes in head position because we tested the CTSIB using the original description in the literature.2 We agree that tilting the head may alter the results of testing in patients with peripheral vestibular disorders. We also agree that future studies of subjects with different types of vestibular pathology should attempt to separate these groups based on type of pathology.

We agree that conditions 1, 2, and 3 (standing on the floor with eyes open, eyes closed, and wearing a visual-conflict dome) should be deleted with caution. As we stated in our report, the only group for which we considered eliminating these conditions were those subjects with peripheral vestibular disorders. This group generally demonstrates less severe instability than individuals with mixed, central, or bilateral vestibular disor-

References