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Study of Test of Balance in Tinnitus and Vertigo Patients

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Abstract: The diagnosis of patient disorders in modern neurootological centers has to include not only history and examination but objective and quantitative tests. In this study, we stress the importance of a short but significant test used to study vestibular function—the vestibular test of balance. The most common and widespread technique used to evaluate a patient's equilibrium in static condition is the projection of the center of gravity with the patient in a standing position, which permits evaluation of visual, somatosensory, and vestibular contributions to stability or equilibrium. Modern physicians can improve their diagnoses by correlating patient history with clinical description and the results of exploration of vestibulospinal, retinoocular, and vestibuloocular systems of vertiginous patients.

Key Words: test of balance; tinnitus; vertigo

In this study, we researched vestibular function through the study of test of balance (TOB), a systematic method for daily clinical evaluation of patients' equilibrium in persons suffering from tinnitus and vertigo, in order to better determine the vestibular diagnosis.

PATIENTS AND METHODS

We reviewed the clinical charts of all patients (N = 100) having a diagnosis of tinnitus and vertigo and seen at our neurophysiological otology clinic in 2003. We recorded gender, age, reason for consultation, and results of the audiological and otoneurological studies [1,2].

In all 100 patients, we performed the test of balance (TOB), using a static platform measuring 50 × 50 cm and having four pressure sensors (one in each corner) with a range of force from 0 to 100 kg each, on which a patient stands. Each sensor produces a small voltage proportional to the pressure supported. The platform holds the necessary electronic devices to amplify these signals, convert them to digital format, and send the information to a computer using a serial port. The computer receives the information from each pressure sensor.

The special software, which runs in Windows, allows complete calculation of the center of gravity (COG) and further analysis. Let us suppose a floor-standing platform having four pressure sensors labeled 1 through 4. When a patient stands on the platform, each sensor receives a pressure or force. The four patient conditions that define each 30-second test are:

- *Test 1*: eyes open, stable surface (EOS); complete equilibrium information
- *Test 2*: eyes closed, stable surface (ECS); somatosensory and vestibular information
- *Test 3*: eyes open, unstable surface (EOU); visual and vestibular information
- *Test 4*: eyes closed, unstable surface (ECU); vestibular information only

The stable condition is performed on an unmodified platform, whereas the unstable condition (tactile information suppressed or very attenuated) is performed using a thick foam cushion over the platform (Fig. 1).

RESULTS

Our preliminary study of TOB, a diagnostic tool useful in the study of the vestibular pathway, only described the results in 100 neurootological patients presenting at our neurophysiological otology clinic in México City.

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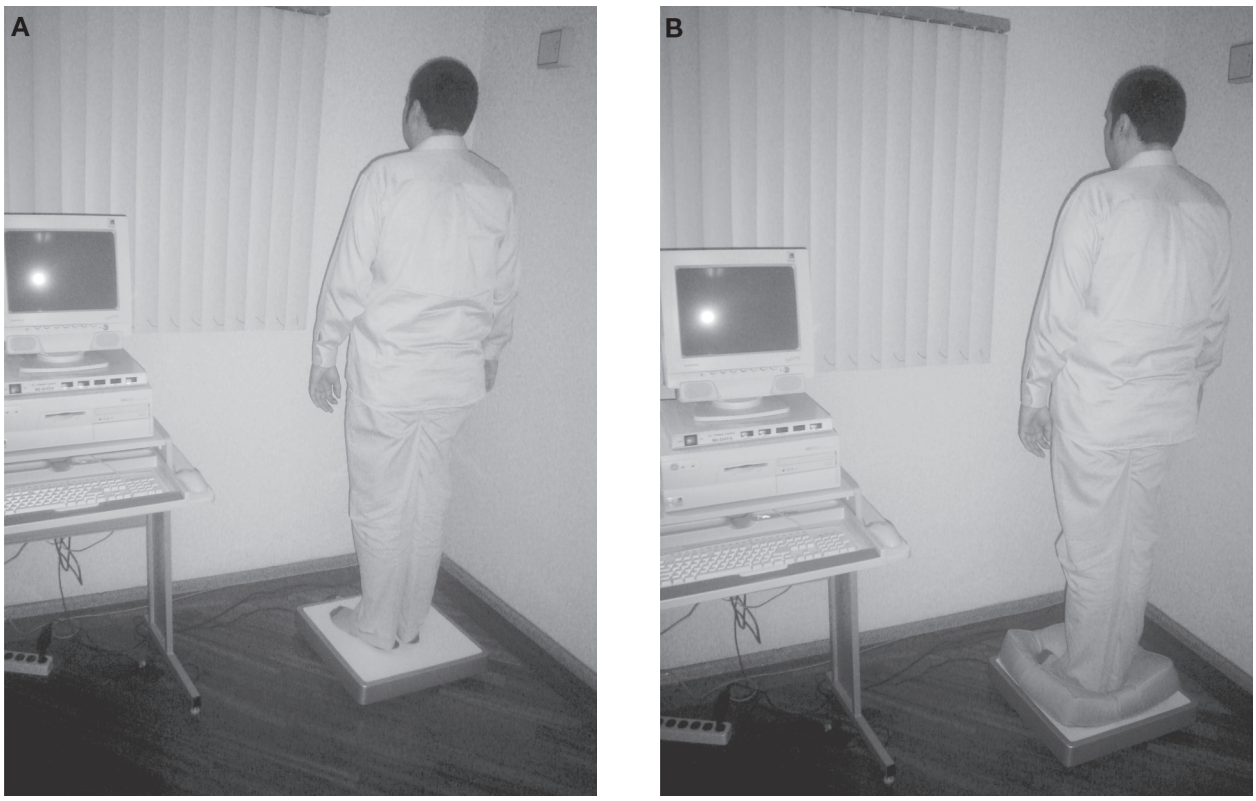

Figure 1. (A) Stable and (B) unstable conditions of test of balance.

These patients underwent a thorough neurootological investigation, including recording of a medical history via Neurootological Data Evaluation–Claussen (NODEC) IV, neurophysiological oto-ophthalmological ear, nose, and throat examination, and TOB.

Of the 100 patients, 70 were female and 30 male. Their mean ages were 49.78 years (women) and 57.20 years (men). Patients aged 21–30 years represented 17% of the cohort, those aged 31–40 years represented 30%, and the group of patients aged 41–50 years comprised 21%, as delineated in Table 1. The patients were found to exhibit a variety of disorders (Table 2). Among those with vertigo, the most frequent symptom was lift sensation (59.05%), followed by tilting and falling sensations (51.04%) and feeling sick (39.02%) (Fig. 2).

Vertigo lasting for up to 1 year was reported by 43% of patients, but the duration in some was less than a day. Spells of vertigo lasting only a few seconds were cited by 72% (Table 3). We found visuocortical pathology in 23.26% of the patient pool and somatosensory pathology in 47.18%, for a total of 70.44% central pathologies, as compared with peripheral (vestibular) pathology, which was noted in 29.56%. The test outcomes regarding the variables of velocity (front-rear and left-right), average velocity, total displacement, equilibrium area, predominant direction, and Romberg index are similar to those of Bergmann and Bertora [3–5] (Table 4).

Table 1. Ages of Patients in Cohort (N = 100)

Age	Percentage of Patients
<30 yr	17
31–50 yr	51
51–70 yr	26
>70 yr	6

Table 2. Disorders in Patient Cohort (N = 100)

Disorders	Percentage
Vertigo	77
Deafness	61
Headache	44
Tinnitus	40
Vomiting	33

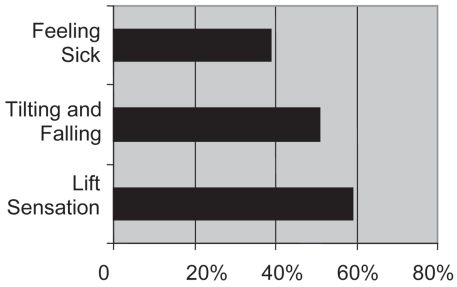

Figure 2. Distribution of vertigo symptoms.

Table 3. Duration of Vertigo

	Percentage of Patients
Length of vertigo history	
Up to 1 yr	43
1–2 mo	23
1 day–4 wk	11
0–1 day	23
Duration of vertigo spells	
Few seconds	72
1–5 minutes	19
1–2 hours	3
Alternating	6

The correlation between our results and those of Bergmann and Bertora [3] was statistically significant, indicating that there is an important association between the two ($p < .0001$) [6]. These results suggest that the TOB, an easy, rapid, noninvasive test, may be effective for diagnosing tinnitus and vertigo. We found the TOB to be helpful in making a preliminary diagnosis in tinnitus and vertigo patients. The parameters and their average about the TOB may be similar in this study, in comparison to other studies made public.

CONCLUSIONS

The TOB is a useful technique for investigating visuocortical, somatosensory, and vestibular function in patients with tinnitus and vertigo. It is effective for scrutinizing peripheral, central, and combined lesions in vertigo. The test can be easily performed in the outpatient department, is not time-consuming, and is not costly.

Table 4. Test Variables

Test of Balance	EOS	ECS	EOU	ECU
Average velocity (deg/sec)	0.9379 0.40–1.13	1.12 0.94–1.53	2.06 0.69–2.13	3.00 1.61–3.64
Total displacement (cm)	35.90 15.5–44.5	42.52 33.9–50.3	61.02 25.3–86.4	83.11 63.0–143.7
Equilibrium area (cm^2)	3.20 0.82–2.50	5.11 1.93–7.09	6.22 0.76–4.05	11.58 8.91–20.13
Predominant direction	–16.19	15.93	–10.39	4.15
Romberg index	134.83 244–443	141.08	173.86 838–1,004	173.86

EOS = eyes open, stable surface; ECS = eyes closed, stable surface; EOU = eyes open, unstable surface; ECU = eyes closed, unstable surface.

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