

# Results of Otovestibular Tests in Mild Head Injuries

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**Abstract:** The neurootological workup of patients with minor head trauma was carried out prospectively. The preliminary results of the ongoing study were derived from 38 subjects (12 female, 26 male) at an average age of 33.5 years. All had been hospitalized after having suffered minimum head trauma followed by a temporary loss of consciousness, by amnesia, or by vomiting. The 38 subjects underwent the examination within 72 hours of the event and were summoned for a follow-up visit 3 months later. The anamnestic data show that the most frequent complaint was dizziness (81%). Tinnitus was noted in fewer than one-half of the patients, with a variety of descriptions. Twenty-six percent complained of hearing loss. The correlation between reported hearing loss and the finding on subsequent behavioral audiometry (within 72 hours after the event) was studied. The sensitivity of hearing loss (as complaint) was found to be only 40%, but its specificity was much higher at 83%. The overall equilibrium reflected in the composite score of the sensory testing in computed dynamic posturography actually worsened between tests. A good correlation was found between posturography results and symptomatology. We concluded that, after minor head trauma, most patients suffer from dizziness, and more than one-half complain of tinnitus or hearing loss. The unsteadiness does not subside within 3 months after concussion. A more protracted follow-up is required to summarize the outcome of head injury from a neurootological point of view. A clear correlation is found between complaints and posturography results. After minor head trauma, pure vestibular injuries are much less frequent than are central lesions. Motor dysfunction is less frequent than are the sensory abnormalities.

**Key Words:** audiometry; head injury; hearing loss; postconcussion syndrome; posturography; tinnitus

Trauma is one of the leading etiologies of disability and loss of work capacity in Western society. In recent years, the number of traffic, military training, occupational, and sports-related accidents has increased [1,2]. Among such events, a significant proportion of those affected suffer head trauma. How-

ever, most of these injuries are mild, with a variety of generated symptoms known jointly as the *postconcussion syndrome*. In the latter, headache coexists with difficulty to concentrate, sleep disorders, and otovestibular disturbances [2]. Frequently encountered complaints are vertigo and disequilibrium with or without hearing loss or tinnitus [3,4].

We could not find in the scrutinized literature any report of the joint use of posturography and evoked potentials for evaluating head trauma victims. Conceivably, a more expanded neurootological workup of head trauma victims with otovestibular symptomatology would en-

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hance our diagnostic proficiency, with the two techniques complementing each other. As of today, the correlation between abnormal findings of complementary otoneurological tests is not known.

## MATERIALS AND METHODS

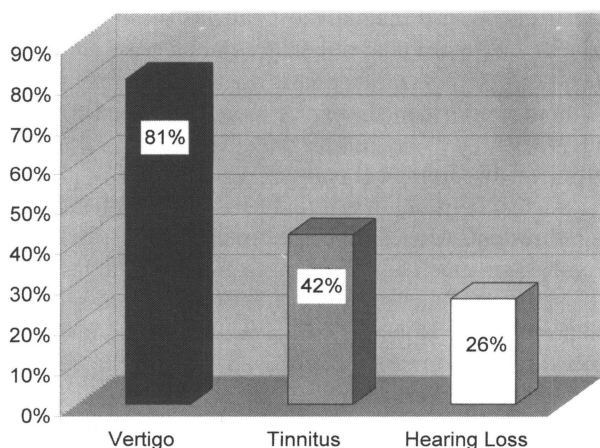
We designed a study in which the neurootological workup of patients with minor head trauma was carried out. The preliminary results of the ongoing study involved 38 subjects (12 females, 26 males) with an average age of 33.5 years. All had been hospitalized after having suffered minimal head trauma that was followed by a temporary loss of consciousness, amnesia, or vomiting. Normal neurological examination and skull radiographs were the selection criteria. Patients with injuries to the lower limbs were excluded.

The 38 subjects underwent the examination within 72 hours of the event and were summoned for a follow-up visit 3 months later. The subjects were required to fill out a questionnaire on the subjective appraisal of their state.

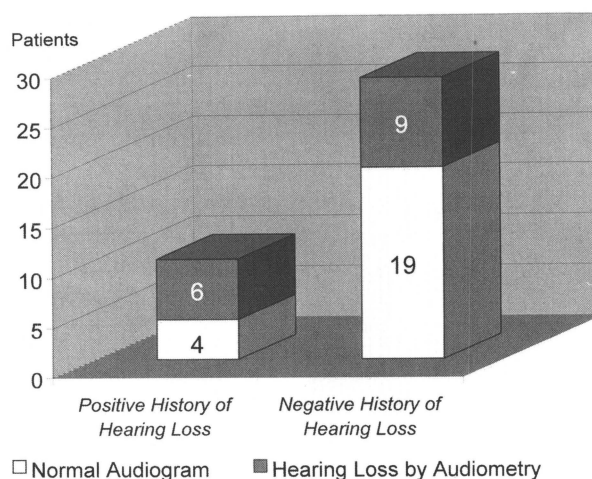
## RESULTS AND DISCUSSION

The anamnestic data are summarized in Figure 1. The most frequent complaint was dizziness, found in 81%. Tinnitus was noted in fewer than one-half of the patients (42%), with a variety of descriptions. Hearing loss was reported by only 26%.

We analyzed the correlation between reported hearing loss and findings on subsequent behavioral audiometry, which was performed within 72 hours after the traumatic events. On the basis of these data, the sensitiv-



**Figure 1.** Symptomatology of minor head injury patients 72 hours after concussion.



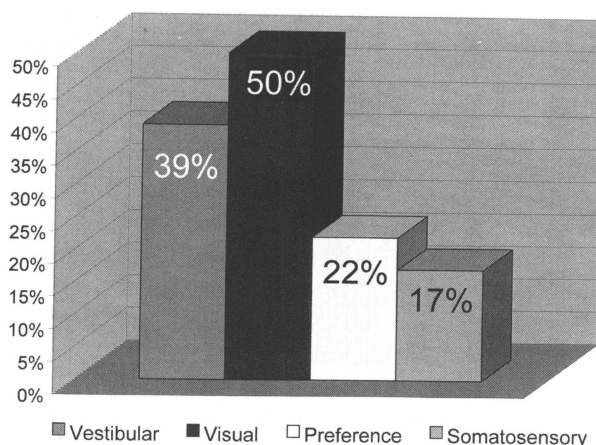
**Figure 2.** Distribution of audiometry results and subjective hearing loss 72 hours after head injury.

ity of hearing loss (as complaint) was poor at only 40%, but its specificity was much higher at 83% (Fig. 2).

Comparison between audiometric results obtained 3 days and 3 months after the traumatic events revealed only a slight abatement in hearing loss over this period: from 58% to 50% (not significant by analysis of variance [ANOVA]).

By contrasting the obtained posturography results in a similar way, one gathers an even more discouraging picture: The overall equilibrium reflected in the composite score of the sensory testing in computed dynamic posturography (CDP) actually worsened between tests: That is, the percentage of patients with a pathological composite score increased from 72% at 3 days after the injury to 83% after 3 months had passed. Nevertheless, the change was not statistically significant. A good correlation was found between posturography results and symptomatology: The majority (81%) of subjects complained of vertigo and, indeed, 69% of these had an abnormal performance on CDP.

Figure 3 presents the distribution of sensory analysis given by the CDP's software; in other words, it determines the state of the systems that are responsible for the deficient equilibrium in patients with a pathological composite score. The graph shows the percentages of tested patients exhibiting an abnormal score of the specific sensory system involved in equilibrium, said scores being obtained 72 hours after head injury. (The sensory analysis results 3 months after concussion were similar.) Eighty percent of subjects with disequilibrium after head injury presented multiple sensory deficiencies, possibly suggestive of a central pathology (which would not be surprising in head trauma). Pure vestibular disturbance was noted in only 13%, which is similar

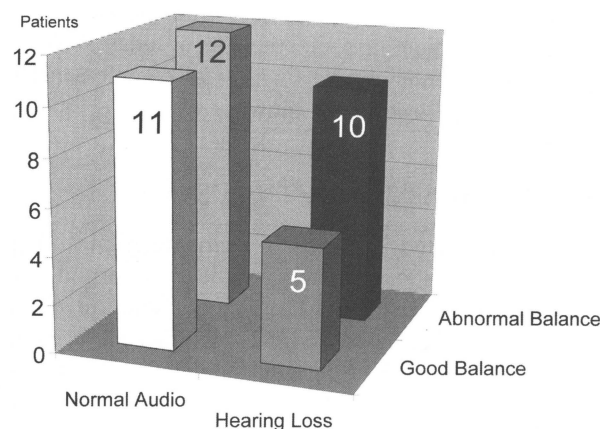


**Figure 3.** The sensory systems responsible for deficient equilibrium in patients having a pathological composite score. Percentages represent the fraction of tested patients found to have an abnormal score of the specific sensory system 72 hours after head injury.

to the results of Himmelfarb and Cohen [5] but slightly higher than the figures previously reported in other studies. However, these works mostly used electronystagmography and the rotary chair as tests of vestibular function, in which the vestibuloocular reflex was tested by stimulating the horizontal semicircular canal. By contrast, the contribution of the other semicircular canals is conceivable in CDP by nature of the anteroposterior sway during testing.

In contrast with the much poorer results from the sensory test, the majority of patients did not show abnormal motor findings. Average scores on the motor organization test of CDP at 72 hours after concussion were 90% normal latency, 5% borderline latency, and 5% prolonged latency. An attempt to explain the phenomenon may be concentrated in the hypothesis that in head injury, the afferent branch of the vestibulospinal reflex arch is the area in which most dysfunction is generated in the form of minute hemorrhages, cupulolithiasis, axonal tear, and cerebral tissue edema. At 3 months after concussion, a worsening of the motor organization test scores was noted relative to the first test: The percentage of borderline latency increased from 5% at 3 days to 17% at 3 months, at the expense of normal results (78%), whereas prolonged latencies remained at 5%. This change was not statistically significant.

Brainstem evoked response audiometry was analyzed next. The interpeak latency differences were abnormal in 52% of subjects immediately after the concussion, whereas an improvement was noted 3 months after the event ( $p < .05$  by ANOVA). An even more significant improvement was witnessed on recording the middle



**Figure 4.** Correlation between audiometric results and overall balance, reflected in the composite score of computed dynamic posturography testing.

latency auditory evoked potentials, from 50% abnormal results at 3 days to 9% at 3 months after the concussion ( $p < .02$  by ANOVA). Soustiel et al. [6] found that the responses obtained from the injured white-gray matter transition zone are sensitive to changes in the state of consciousness and also have a bearing on the prognosis. With this in mind, the tentative conclusion—that a significant reduction in pathological results 3 months after the injury indicates a favorable prognosis—is most welcome.

The graph in Figure 4 shows a lack of clear correlation between the audiometric results and overall balance as it was yielded by CDP. The absence of such a correlation would be very unusual if the pathology were peripheral.

## CONCLUSIONS

After minor head trauma, most patients suffer from dizziness, and more than one-half complain of tinnitus or hearing loss. The unsteadiness does not subside within 3 months after concussion. A more protracted follow-up is required to summarize the outcome of head injury from a neurootological point of view.

A clear correlation is found between complaints and CDP results. After minor head trauma, pure vestibular injuries are much less frequent than are central lesions.

Motor dysfunction is less frequent than are sensory abnormalities. However, when they occur, a tendency toward deterioration is observed during the first 3 months after concussion.

Brainstem evoked response audiometry results improve in time. This is especially true of middle latency auditory evoked potentials, a finding indicative of good prognosis.

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