Case Report

Isolated otolithic dysfunction and vestibular rehabilitation results: A case report

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ABSTRACT

A 33-year-old male patient presented with dizziness which increased with head movements like a self-reported sensation of walking-on-pillows. Routine test results were within the normal range. The vestibular evoked myogenic potentials (VEMP) results were unable to be obtained and the sensory organization test (SOT) score was 7%. The patient was given a six-week customized vestibular rehabilitation program. After his complaints alleviated, his SOT scores were improved and VEMP waves were able to be obtained. In conclusion, clinicians should keep in mind that some patients may present with isolated otolith dysfunction and customized vestibular rehabilitation may offer benefits to these patients.

Keywords: Otolith dysfunction, otolith, regeneration, vestibular rehabilitation.

The vestibular labyrinth is composed of two functionally and anatomically distinct parts, the semicircular canals, which sense angular acceleration, and the otolith organs, which sense the linear acceleration and gravity.[1] The otolith system detects linear accelerations, by which it senses head translations in three dimensions. The system also detects head tilts relative to gravity vector which serves as an absolute reference in space.[2] These different parts can be evaluated using several test methods.

The semicircular canals and their functions can be examined using the caloric test and video head impulse test (vHIT). The evaluation of the otolith functions can be performed with the vestibular evoked myogenic potentials (VEMP) generated from the contracted sternocleidomastoid muscles (SCMs) or extraocular muscles (i.e., inferior rectus and inferior oblique) in response to different stimuli. Thus, cervical VEMP (cVEMP) and ocular VEMP (oVEMP) in addition to caloric test and vHIT enable the evaluation of all five receptors of the vestibular organ and specify the function of the vestibular system.[3] The functional postural abilities and sensory organization of the vestibular system can be also evaluated through the computerized dynamic posturography (CDP).

Although the functions of the otoliths, maculae utriculi, and maculae sacculi have been well documented, the treatment of the otolith functions and treatment outcomes are still a grey area for the clinicians. Herein, we present a case of isolated peripheral otolith dysfunction which could be identified by objective measurements who underwent a successful vestibular rehabilitation program.

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CASE REPORTS

A 33-year-old male patient presented with dizziness which increased with head movements like a self-reported sensation of walking-on-pillows for the past five days. His medical history revealed no use of any pharmacological medication.

His hearing thresholds on both sides were within the normal range. His tympanometry results, bedside tests (Romberg, Unterberger and cerebellar tests), gait stability, hyperventilation-induced nystagmus, and Subjective Visual Vertical (SVV) were all normal. His videonystagmography (VNG) test battery results (including positional tests and caloric test) were in normal range and no canal paralysis was detected. The vHIT tests for all six canals were normal with the gains within the normal range. There was no covert and overt saccades.

No cVEMPs and oVEMPs were generated in response to air-conducted sound signals at 500 Hz tone burst for both sides (Figures 1 and 2). His sensory organization test (SOT) using the CDP scores showed a composite equilibrium score of 7% below the normal range, and visual and vestibular response scores were also below the normal range in the sensory analysis testing. However, strategy analysis and the center of gravity (COG) alignments were within the normal range (Figure 3). The patient fell on the left unilateral stance and the weight bearing/squat tests showed right leg dependence (Figure 4).

Based on these test results, the patient was given a customized six-week vestibular rehabilitation program including home-based exercises. The program consisted of vestibular adaptation exercises, habituation exercises, balance/gait activities, and general fitness training. After a six-week rehabilitation program, his complaints completely resolved, and repeated vestibular test results were within the normal range, including improved SOT scores, a composite equilibrium score of 84%. In addition, the visual and vestibular responses were found to be within the normal range for the sensory analysis and the strategy analysis and COG alignment scores were also within the normal range. In the unilateral stance tests, the patient only fell down when he was on the left side and his eyes were closed. The weight-bearing squat showed right leg dependence once again. The patient's vHIT results following vestibular rehabilitation were

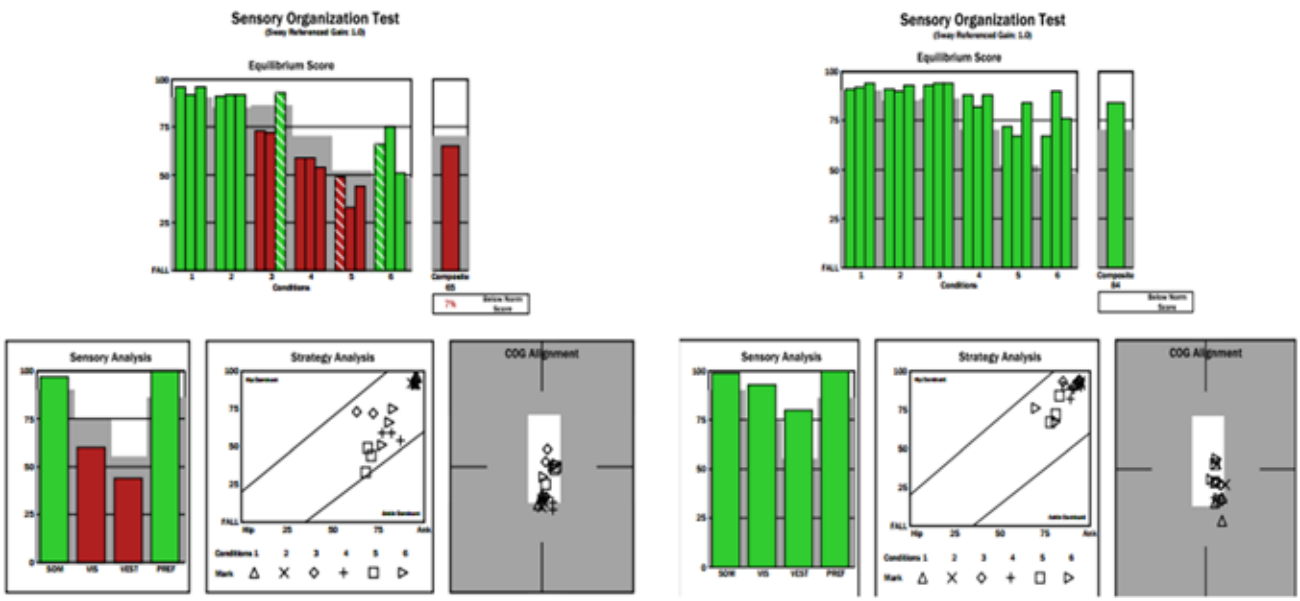

Figure 1. Cervical vestibular evoked myogenic potentials results before and after rehabilitation (right and left side, respectively).

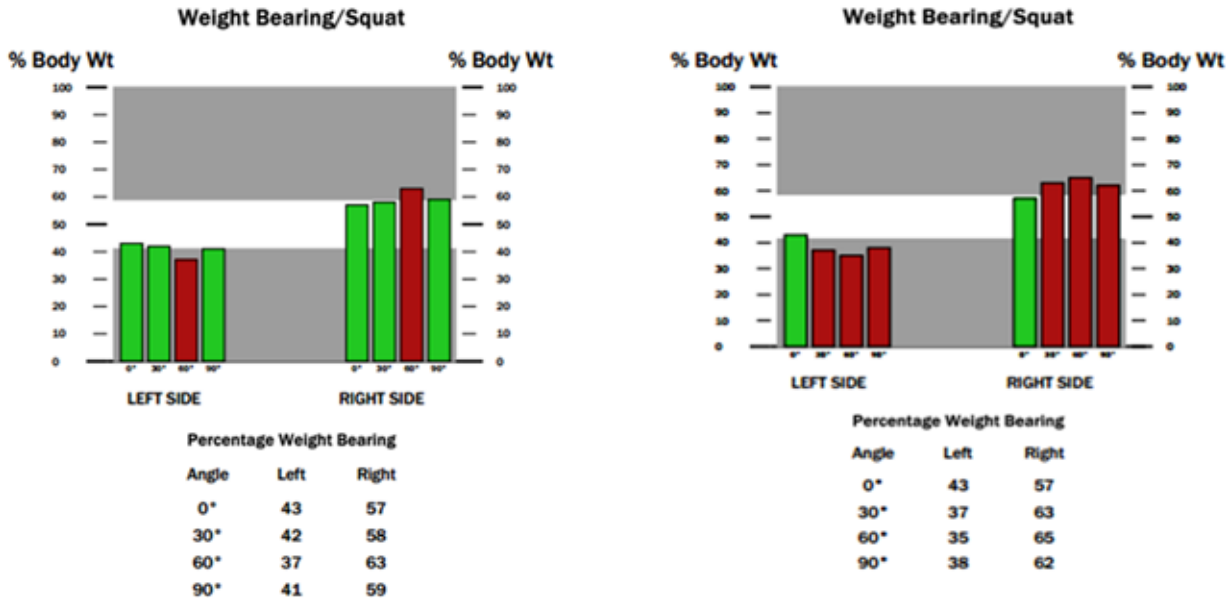

Figure 2. *Ocular vestibular evoked myogenic potentials results before and after rehabilitation (right and left side, respectively).*

found to be within the normal range. The VEMP tests were re-administered and the results were obtained at the end of the treatment. The cVEMP amplitudes of the p13-n23 complex were recorded bilaterally and the oVEMP amplitudes were recorded just for the right side.

A written informed consent was obtained from the patient.

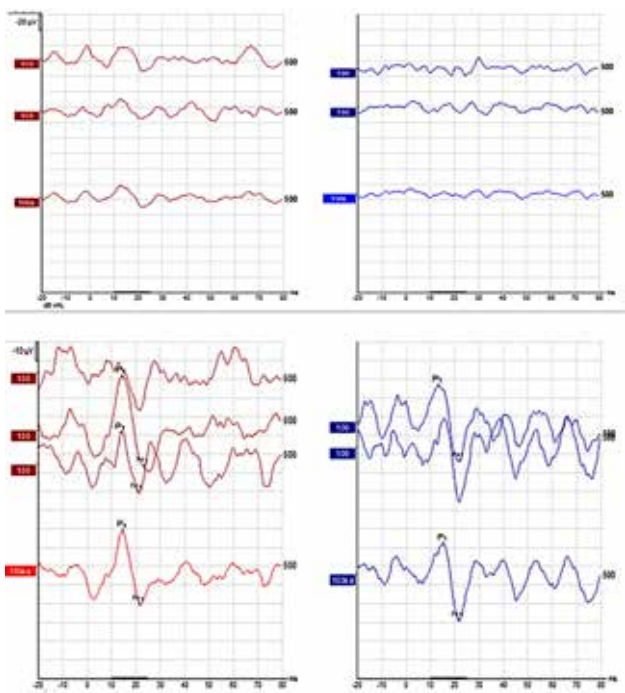

Figure 3. *Sensory organization test results before and after rehabilitation.*

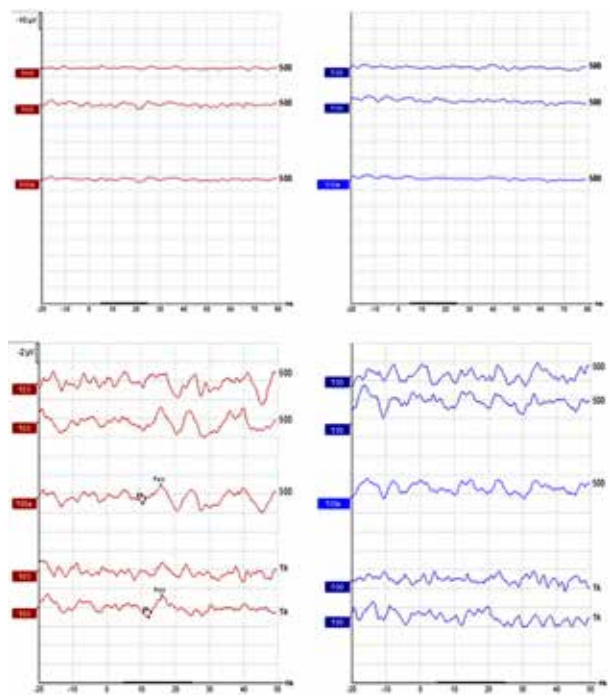

Figure 4. *Weight-bearing squat results before and after rehabilitation.*

DISCUSSION

It is well-documented that patients with otolith disorders typically describe their sensations as movements/feelings like walking-on-pillows, feeling drunk, or tumbling.[4] In the literature, there are few studies describing isolated otolithic dysfunction and this pathology was first named as otolithic vertigo by Murofushi et al.[5] Although there is no standard diagnostic criterion for isolated otolithic dysfunction, symptoms of the disease and current understanding of the physiology of the vestibular system suggest us this pathology.

Some particular cases show different aspects and effects of the otolith functions. Saka et al.[6] reported dizziness in the anteroposterior direction originating from the saccular and/or utricular dysfunction. Seo et al.[7] suggested that VEMP examinations could be useful in the diagnosis of dizziness of unknown origin. In their study, five of every six patients with abnormal VEMP waves complained of a falling sensation associated with possible otolith dysfunction.

Basta et al.[4] defined that the ankle-sway referenced computerized dynamic posturography (CDP) is the most sensitive objective measurement in patients with combined sacculo-utricular disorders. The patient`s results support this opinion. The SOT results (76.9%) indicated that the CDP had limited specificity in utricular disorders, while having reasonable specificity in sacculo-utricular disorders, which offer a greater impact on the human balance control.

The interesting finding for this particular case was recovery of the VEMP results. Murofushi et al.[5] also reported the recovery of cVEMP results of patients with vestibular neuritis. Our patient did not show any symptoms of vestibular neuritis, leading us to a peripheral otolithic dysfunction rather than a neuronal one. Cell recovery has been advocated as a probable way for vestibular rehabilitation and improved test results.[8] However, in a study, Luis et al.[9] suggested that this was unlikely for their patient due to limited time (30 days). Therefore, we speculate that our patient has probable cell recovery due to a longer rehabilitation peroid (42 days). Although cell recovery theory and its effect on vestibular systems have yet to be investigated in humans, there are studies yielding promising results in animal models and cell cultures. These changes in the VEMP results may be dependent on this cell recovery mechanism, although further researches are needed to understand the otolith mechanism and its defects and to develop rehabilitation options in the future.

In conclusion, although there are few reports on this subject in the literature, isolated otolithic dysfunction and the clinical use of VEMP are critical aspects that should be kept in mind. Successful results with vestibular rehabilitation seems possible in otolithic dysfunction patients.

Declaration of conflicting interests

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