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Virtual Reality in Vestibular Rehabilitation for Mal de Débarquement Syndrome: A Case Report

Mal de Debarquement Sendromunda Sanal Gerçeklik ile Vestibüler Rehabilitasyon: Olgu Sunumu

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ABSTRACT

Mal de débarquement syndrome (MdDS) is a condition characterized by symptoms of imbalance and a sensation of swaying, particularly after sea travel, that occur following the cessation of movement. It typically appears after long sea voyages but can also be seen after airplane, train, or car travel. The exact cause of MdDS is unknown, but it is thought to involve a disruption in the systems in the brain that govern balance and motion perception. While there is no definitive treatment, therapy, and medications can sometimes alleviate symptoms. The aim of this case report was to demonstrate the success of using virtual reality in the treatment process of a 51-year-old male patient diagnosed with MdDS, and thus to raise awareness among clinicians to effectively manage the not well-known MdDS.
Keywords: Mal de débarquement syndrome; dizziness; virtual reality; vestibular rehabilitation.

ÖZ

Mal de débarquement sendromu (MdDS), özellikle deniz yolculuğundan sonra ortaya çıkan ve hareketin durmasının ardından dengesizlik ve sallanma hissi gibi belirtilerle karakterize edilen bir hastalıktır. Genellikle uzun deniz yolculuklarından sonra ortaya çıkmakla birlikte, uçak, tren veya araba yolculuklarından sonra da görülebilmektedir. MdDS'nin nedeni tam olarak bilinmemektedir, ancak beyindeki denge ve hareket algısını yöneten sistemlerde bir bozulma olduğu düşünülmektedir. Kesin bir tedavi yöntemi bulunmamakla birlikte, bazı durumlarda terapi ve ilaçlar belirtileri hafifletebilir. Bu vaka raporunun amacı, MdDS tanısı konulan 51 yaşında bir erkek hastanın tedavi sürecinde sanal gerçekliğin kullanılmasının başarısını göstermek ve böylece yeterince iyi tanınmayan MdDS'yi etkili bir şekilde yönetebilmek için klinisyenler arasındaki farkındalığı artırmaktır.
Anahtar kelimeler: Mal de débarquement sendromu; baş dönmesi; sanal gerçeklik; vestibüler rehabilitasyon.

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INTRODUCTION

Mal de débarquement syndrome (MdDS) is a movement-induced oscillatory vertigo disorder that persists even after the movement has stopped. MdDS is a persistent oscillatory vertigo illness following passive movements such as sea, air, or land travel (1). Although MdDS involves a sensation of phantom motion, it is not described as genuine rotational vertigo, and patients usually do not report symptoms

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of motion sickness (2). MdDS is classified into two as motion-triggered (MT-MdDS) and non-motion-triggered MdDS (non-MT MdDS), which start spontaneously or in other ways (3).

Unlike dizziness from vestibular disorders or motion sickness, MdDS symptoms typically improve when the person is re-exposed to motion (4). Although various treatment options such as pharmacological therapies, neuromodulation, and vestibulo-ocular reflex (VOR) rehabilitation are available, access to these methods is limited, and they often focus on addressing secondary symptoms rather than resolving the underlying issue. Therefore, finding effective treatment options that can alleviate MdDS symptoms is of great importance (5).

Symptoms are typically triggered by sea, air, and car travel (6). Other symptoms include disorientation, postural instability, imbalance, fatigue, cognitive impairments, and kinesiophobia (7). Visual sensitivity has been reported in MdDS patients (8). MdDS patients may exhibit mild vestibular imbalance with rotation during the Unterberger test (9).

Vestibular rehabilitation is a therapeutic approach used to treat dizziness and balance disorders. It is based on central neuroplasticity mechanisms that facilitate vestibular compensation, including habituation, adaptation, and substitution. Vestibular rehabilitation is known to be effective for many vestibular disorders (10). Virtual reality systems have recently been used as an effective therapy method in the field of vestibular rehabilitation (11). The purpose of using virtual reality technology in vestibular rehabilitation is to reduce symptoms, use a realistic visual environment that causes retinal slip and habituation, increase VOR gain and optokinetic responses, and improve postural stability (12).

The diagnostic criteria for MdDS are as follows:

1. A sensation of non-spinning vertigo (e.g., rocking, bobbing, or swaying) that begins after passive movements such as sea, air, or land travel, or exposure to virtual reality.
2. Occurs within 48 hours of disembarking from a moving vehicle such as a boat, plane, or car.
3. Symptoms temporarily reduce with passive movement exposure (e.g., driving).
4. Symptoms persist for more than 48 hours.

MdDS can be termed 'developing' if observed for less than a month while symptoms persist; 'transient' if symptoms resolve within a month or sooner and are observed at least until the resolution point; or 'persistent' if symptoms last longer than a month. Individuals with MdDS may develop accompanying symptoms such as spatial disorientation, visual motion intolerance, fatigue, and exacerbation of headache or anxiety (1).

This case report aimed to present using virtual reality as a treatment option for MdDS in a 51-year-old male patient.

CASE REPORT

A 51-year-old male military helicopter pilot presented to our clinic with a complaint of a sensation of swaying for the past 7 months. His medical history included benign paroxysmal positional vertigo (BPPV), which had resolved with maneuvers. He was examined by a neurologist, cardiologist, and otolaryngologist at an external center, but no diagnosis was made. Our patient underwent anamnesis, physical examination, and audio-vestibular evaluation. For auditory assessment, an AC40 model audiometer and an AT235H model tympanometer (Interacoustics, Denmark) were used, and for vestibular evaluation, a VE525B model VNG device and a vHIT device (Interacoustics, Denmark) were utilized. Neurological examination and radiological assessment were conducted to rule out central pathologies. Magnetic resonance imaging (MRI) results were normal. A video head impulse test (v-HIT) was performed to evaluate the semicircular canals, and the results were normal. Audiometry tests showed bilateral normal hearing. Acoustic reflex measurements revealed bilateral type A tympanogram and normal immittance measurements. Romberg and tandem Romberg tests were normal. Unterberger test showed a 30-degree turn to the right. Dysmetria and dysdiadochokinesia were normal. Videonystagmography (VNG) test was normal. The dizziness handicap inventory score was 56, the Beck anxiety inventory score was 20, and the visual vertigo analog scale score was 44. Based on the absence of any pathological findings in the tests and the patient's history, the patient was diagnosed with MdDS.

The Interacoustic Virtualis BalanceVR device was used for treatment. As a treatment, virtual reality vestibular rehabilitation was performed once a week for a total of 12 sessions, with each session lasting 1 hour. The subjective visual vertical (SVV), optokinetic (horizontal, rotatory, and vertical) tests, optical flow, car, sea, elevator, escalator, target tracking, metro, city, and shopping mall simulations available in the Virtualis BalanceVR device were used. Among these rehabilitation modules, those that could provoke the patient's condition were individually selected. This selection was made by having the patient experience simulations of daily activities and environments that caused discomfort. The patient's discomfort thresholds were determined, and vestibular rehabilitation was initiated at one level below these thresholds. In the sessions, no higher-level parameters were introduced until sufficient adaptation had developed between the parameters and variables, and the patient was able to tolerate their symptoms. The difficulty level was increased with each session. The patient was standing. In the first session, he struggled with all of them, experiencing a sensation of swaying and dizziness. By the end of the 12th session, he was able to perform all of them. In the evaluation conducted after the sessions, the dizziness handicap inventory score was found to be 18, the Beck anxiety inventory score was 14, and the visual vertigo analog scale score was 6. The patient reported that his complaints had been resolved.

DISCUSSION

Individuals with MdDS describe swaying symptoms after sea, air, or land travel. These symptoms may occur due to the VOR failing to adapt to head rotation. Dai et al. (13) developed an optokinetic stimulation (OKS) paradigm for the treatment of MdDS and suggested that a treatment protocol based on the readaptation of the VOR alleviates the perception of self-motion. They treated a total of 24 MdDS patients who were asked to watch a full-field rotating visual stimulus inside an OKS cabin while turning their heads from side to side.

In a study by Yakushin et al. (14), the effectiveness of virtual reality glasses with a limited visual field in simulating a laboratory environment for MdDS treatment was examined in 5 patients. All five patients in this study responded positively to treatment with limited-area horizontal optokinetic nystagmus (OKN) stimulation. Therefore, limited-area OKN stimulation could be an effective stimulus for the activation of velocity storage, which can be used in the treatment of MdDS.

In a study by Hoppes et al. (15), a virtual reality city scene and optokinetic stripes were used in a computer-assisted rehabilitation environment for the treatment of MdDS. During the treatment, the patient was seated in a chair. Due to the patient's symptoms disappearing after the second session, they did not attend the third session. In our study, the virtual reality treatment consisted of 12 sessions, each lasting 1 hour, once a week, with the patient standing. The SVV, optokinetic (horizontal, rotatory, and vertical) tests, optic flow, car, sea, elevator, escalator, target tracking, metro, city, and shopping mall simulations were used.

There is no definitive treatment for MdDS. However, it can be controlled with benzodiazepines, antiemetics, selective serotonin reuptake inhibitors, tricyclic antidepressants, beta-blockers, or anticonvulsants. In most patients, antiemetics are tried as a first-line treatment, but in many cases, this is not sufficient, and additional treatment is required (16). In our study, we found that virtual reality vestibular rehabilitation could be effective in treatment.

It has also been explained several times in studies that re-exposure to passive movement can cause up to 80% temporary reduction in MdDS symptoms (7). Therefore, by providing a realistic environment with virtual reality, we aimed to improve postural stability by increasing VOR gain and optokinetic responses in our patient.

CONCLUSION

Virtual reality simulations provided an exact representation of the environments in which the patient felt discomfort during daily activities, supporting the adaptation of the vestibular system and contributing to the control of symptoms. These findings suggest that virtual reality vestibular rehabilitation could be an effective method for the treatment of MdDS. Further studies involving larger patient groups and long-term follow-up are needed to support the results. Due to its rarity, more studies are needed to understand the therapeutic methods for treatment.

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