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ORIGINAL ARTICLE

Computer-Assisted Training as a Complement in Rehabilitation of Patients With Chronic Vestibular Dizziness—A Randomized Controlled Trial

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Abstract

Objective: To compare a computer-assisted home exercise program with conservative home-training following printed instructions in the rehabilitation of elderly patients with vestibular dysfunction.

Design: Single-blind, randomized, controlled trial.

Setting: Geriatric department of a university hospital.

Participants: Patients with chronic dizziness due to vestibular dysfunction (N=63) were randomly assigned to either rehabilitation in the clinic followed by computer-assisted home exercises (intervention group: n=32) or rehabilitation in the clinic followed by home exercises according to printed instructions (control group: n=31).

Interventions: Patients in the intervention group received assisted rehabilitation by a computer program.

Main Outcome Measures: Measurements at baseline and at 8 and 16 weeks were compared. These included the One Leg Stand Test, Dynamic Gait Index, Chair Stand Test, Motion Sensitivity Test, Short Form-12, Dizziness Handicap Inventory, and visual analog scale.

Results: Both groups improved significantly during 16 weeks of rehabilitation. However, neither *t* tests nor repeated-measures analysis of variance demonstrated any significant differences between the 2 groups. The overall compliance rate to computer program exercises during 16 weeks was 57%.

Conclusions: A computer-assisted program to support the home training of elderly patients with vestibular dysfunction did not improve rehabilitation more than did printed instructions.

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Dizziness is considered to be the most common complaint of patients 75 years and older.[1] Sloane and Baloh[2,3] reported that 46% of 116 patients older than 70 years referred to a neurootology clinic for dizziness presented with vestibular disorders. Also, a study of 6785 persons included in the U.S. National Health and Nutrition Examination surveys showed a significant increase in the prevalence of vestibular dysfunction with age.[4]

A 2012 Cochrane review demonstrated that about 30% of people 65 years or older experience a fall, with a higher incidence among older people living in institutions.[5,6] Ninety-five percent of all hip fractures resulting in hospitalization, disability, or death are caused by falls.[7] Vestibular dysfunction is recognized as an intrinsic factor leading to falls,[8] and vestibular rehabilitation (VR) has been shown to reduce the risk.[8-10] A Cochrane review concluded that evidence for the efficacy of VR in patients with vestibular dysfunction was moderate to strong.[11] Another review looked at the effects of VR in middle-aged and older adults and found evidence for a positive effect of VR in elderly patients with vestibular disturbances.[12] Numerous studies of patients with

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chronic vestibular dysfunction indicate that individualized treatment strategies are more useful than general protocols; hence, VR planning is a specialized task.[13,14] Several authors report that a reduction in dizziness by VR can be achieved only by combining rehabilitation at a clinic with daily home exercises.[12,15] However, compliance with home exercises can be poor among elderly patients.[16,17]

The development of video games over the last decade has led to programs designed to rehabilitate or train their players.[17,18] A generally accepted view is that video games may improve rehabilitation, but their practicality and benefits require validation. So far, the games have been used in clinical settings, but not in home environments where an important proportion of VR must occur to be successful.[18]

The objective of the study was to compare a computer training program with conservative home-training according to printed instructions in the rehabilitation of elderly patients with vestibular dysfunction.

Methods

A possible support for home rehabilitation may be the computer training program "Move It To Improve It" (Mitii).[a] It has been used to home-train patients with cerebral palsy. Its exercises are both motivating and guiding.[19] Mitii represents a "low-tech" solution that simply requires a webcam-enabled computer. For the present study, the program was adapted for patients with vestibular dysfunction. The project took place in the Department of Geriatrics, The Falls Prevention Clinic, Aarhus University Hospital, Aarhus C, and in the ENT Department, Aarhus University Hospital, Aarhus C.

Design

This randomized study of patients with VR compared home exercises supported by the Mitii computer program with a control group given printed instructions. An assessor blinded to the exercise procedures examined all participants at baseline and after 8 and 16 weeks of exercises.

The study was approved by the Danish National Committee on Health Research Ethics (project ID M-20090189) and the Danish Data Protection Agency (project ID 1-16-02-84-09). All participants gave informed and signed consent.

Participants

All patients (≥65y) presented with stable peripheral, central, and/or mixed vestibular dysfunction. Some were recruited from the Fall Clinic, Geriatric Department, Aarhus University Hospital, Denmark, after referral by their general practitioners or from the Emergency Department at Aarhus University Hospital. Others replied to a newspaper advertisement asking for volunteers. A geriatrician evaluated the causes of the patients' falls. Those with vestibular dysfunction who agreed to participate in the project were referred to the Ear, Nose and Throat Department at Aarhus University Hospital to verify the diagnosis of vestibular dysfunction. Diagnostic tests comprised vestibular evoked myogenic potentials; subjective visual video head impulses (vertical and horizontal); spontaneous nystagmus; the bithermal caloric vestibular ocular reflex test (including visual suppression); an oculomotor test including saccades, smooth pursuit, and optokinetic responses; the Roll test; the Dix Hallpike, Hennebert gaze-induced nystagmus; and the Romberg nystagmus test.

Exclusion criteria comprised unstable peripheral vestibular dysfunction, that is, Menière disease, benign paroxysmal positional vertigo, and acute neuronitis vestibularis. Other exclusion criteria were poor vision (≤6/60), contraindications to exercise therapy, significant cardiac problems, use of medicines with potential vestibular adverse effects (benzodiazepines and sedatives), dementia (Mini-Mental State Examination scores of <27, or a history suggesting dementia), stroke in the previous 6 months, other cognitive dysfunctions, and hip fracture within the last 3 months.

List of abbreviations:

Mitii **Move It To Improve It**
VR **vestibular rehabilitation**

Sample size and randomization

Findings of a previous rehabilitation exercise trial in patients with dizziness showed a mean improvement of 6.6±8.4 seconds on the One Leg Stand Test for the intervention group compared with 0.4±6.9 seconds for the control group.[20] On the basis of these figures, we expected a mean improvement of approximately 6 seconds for the intervention group compared with the control group in the present study. Hence, with a 2-tailed significance of 5%, 80% power, and an expectation of 15% dropouts, the sample size was estimated at 29 patients per rehabilitation group.

Randomization after screening and before baseline assessments was provided by a central computer program with permuted block sizes and stratification according to peripheral, central, or mixed vestibular dysfunction. Accordingly, the computer program randomized patients to various blocks of 3, 6, or 9 patients and assigned a total of 32 patients to the intervention group and 31 to the control group (fig 1).

Intervention

Patients in the intervention and control groups received identical rehabilitation training at the hospital twice a week for 16 weeks. For both groups, rehabilitation at hospital was combined with home exercises. The intervention group was provided with a specifically adapted computer-based Mitii program, whereas the control group was given a printed home-training program. Rehabilitation aimed at (1) endurance training, (2) vestibular ocular reflex and cervical ocular reflex training for gaze stability, (3) resetting the vestibular ocular reflex gain, (4) enhancing smooth-pursuit eye movements, and (5) using somatosensory and vestibular inputs for postural control.

The Mitii training program was set up in the participants' homes using an Internet-connected computer and a web camera connected to a cloud-based interactive training system using the Adobe Flash technology.[b] The system was developed by a collaboration between the Helene Elsass Centre, the Headfitted Software Development Company, and the University of Copenhagen.[21-24]

Participants logged into the Mitii website and accessed their individualized training program. The specific content and progression of the program were based on monthly evaluations of each patient's performance. The level of difficulty was adjusted by increasing the task challenges (speed, number of repetitions, placing of target and pick-up area on the screen, size of objects, time to react, etc). A sequence of individual tasks and games was