

Letter to the Editor

Role of head-mounted displays in enhancing vestibular rehabilitation effects: Comment on “Evaluation of the effectiveness of a Virtual Reality-based exercise program for Unilateral Peripheral Vestibular Deficit”

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Dear Editor,

We would like to express our sincere gratitude to Miracelli et al. for their interest in our research and we would like to elaborate on the use of Head Mounted Displays (HMD) in vestibular rehabilitation.

A key concept in virtual reality is “immersion” – a sense of physical “self” in a non-physical, artificial world. Achieving high immersion requires multisensory stimulation. Out of the different stimuli the most important seems to be visual input delivered in high detail, realistic graphics. Application of HMDs to virtual reality experience greatly improves immersion, because it creates a stronger sensory mismatch between the vestibular system and visual input. However, it has been reported that higher detail visual realism in HMDs causes more cybersickness symptoms like headaches, dizziness, nausea and eye stress [1]. In time these symptoms alleviate [2, 3], which is most likely caused by vestibular compensation mechanisms and a shift from visual dependence to proprioceptive and vestibular input predominance. It may be hypothesized that more visually dependent

patients are prone to cybersickness, but this requires further investigation. The issue of cybersickness in wearable devices for virtual reality is a subject of study, and it has been reported that dynamic focus of the visual field is an important factor in symptom presentation [2]. Nonetheless, around 20% to 80% of the population experience cybersickness in VR environments [4].

In our study [5], VR was displayed on a flat screen 2D display. None of the patients complained of cybersickness because they could locate external reference points for their visual input. We are aware of the limitations of this approach, where application of HMDs would further enhance the sensory conflict [3] and possibly cause a greater improvement in symptoms, but also decrease patients’ tolerance of the VR therapy due to possible cybersickness. Moreover, a VR system based only on HMD allows the clinician to track only head and eye movements, whereas a hybrid system as described in our study can record the motion of extremities and COP displacement.

We would like to propose an alternative, novel approach, which utilizes Augmented Reality (AR). In this interactive environment computer generated perceptual information overlays with the physical world “augmenting” the sensory input. In comparison

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59 to VR, AR does not completely replace the visual
60 information and maintains external reference points,
61 which prevent strong motion sickness. Visual AR can
62 be delivered by different display measures – in one
63 of our exercises – The Meteorites – a patient’s own
64 posture was projected into the virtual world. This is
65 a simplified approach to AR, which can be improved
66 by the application of Head Mounted Displays to a
67 hybrid unit as described in our study.

68 This new concept in rehabilitation requires fur-
69 ther investigation and we hope that a multi-centered
70 research study would be possible in the near future.

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