A Case Report: Balance Training with Virtual Reality in Patients with Bilateral Peripheral Vestibulopathy

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Abstract

The use of computerised imaging technologies in vestibular rehabilitation is a new concept. We aimed to examine the effects of virtual reality in a bilateral vestibulopathy patient. The subject was a 22-year old male patient. The bilateral semi-circular channels of patient were ossified, which showed advanced stage sensorineural hearing loss. Balance was analysed with Berg balance Scale (BBS), state of balanced feeling with visual analogue scale (VAS), and daily living activities with the activities-specific balance confidence scale (ABC). The scales were applied before and after treatment. The patient's balance was treated with virtual reality for 18 sessions, after which the patient was feeling his balance better. The patient's VAS score before rehabilitation was 5 and later it was 7. The ABC scores changed from 60 to 90. The BBS score was 51 before rehabilitation and later it was 56. Balance rehabilitation was successful in bilateral vestibulopathy.

Keywords: Bilateral vestibulopathy, virtual reality, balance, vertigo.

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1. Introduction

The vestibular, visual and proprioceptive system is responsible for achieving balance. The balance is achieved through three stages: information, perception of information at the centre of balance and preparation, and application [1]. In patients with bilateral vestibulopathy, the main objective in rehabilitation treatment is to ensure the maximal usage of vestibular function, immobilising the visual area through the use of visual and somatosensorial clues, providing postural stability and preventing falling [2]. Virtual reality is a technology which creates the impression in people's minds that three-dimensional pictures and animations created in the computer environment exist in a real environment. It also makes it possible for them to interact with the objects in the environment. Virtual reality has recently been started to be used in education (mathematics, science and medicine) and other areas (military and airline industries). The use of computerised imaging technologies in vestibular rehabilitation is a new concept. The basis of virtual reality is the use of realistic visual environments which cause retinal slips and trigger adaptation with the help of devices [3].

2. Case Presentation

The ethics committee gave its approval on 6 May 2014, and informed consent was obtained from the participant.

A male patient aged 22 with bilateral vestibulopathy was included in the study. The patient was informed about the study, and he was asked to read the voluntary consent form and sign it. The patient's history was recorded. A hearing test and computerised tomography (CT) was applied.

The patient included in our study was evaluated prior to starting the vestibular rehabilitation programme with the visual analogue scale (VAS), activities-specific and balance confidence scale (ABC) and Berg balance scale (BBS).

The patient's balance status was evaluated with VAS. The patient was asked to evaluate the balance status he felt subjectively between 0 (very bad) and 10 (very good).

The patient with bilateral peripheral vestibulopathy was treated for 18 séances and he was given balance training during this time through virtual reality. The game included balance exercises such as catching and functional reaching. After the treatment, the patient was re-evaluated with VAS, ABC and BBS.

The patient stated in his history that he was hospitalised after an infection which began with fever and coughing and that hearing loss and vertigo developed afterwards. In the audiological evaluation, it was seen that there was a very advanced level of bilateral sensory neural hearing loss. The patient used bilateral hearing aids. When the CT was analysed, it was seen that all semi-circular canals were bilaterally ossified.

2.1. VAS Findings

The patient, who evaluated his balance status as five pre-treatments stated that it went up to seven post-treatments (Figure 1). A 20% increase was achieved in the balance status, which was evaluated with VAS.
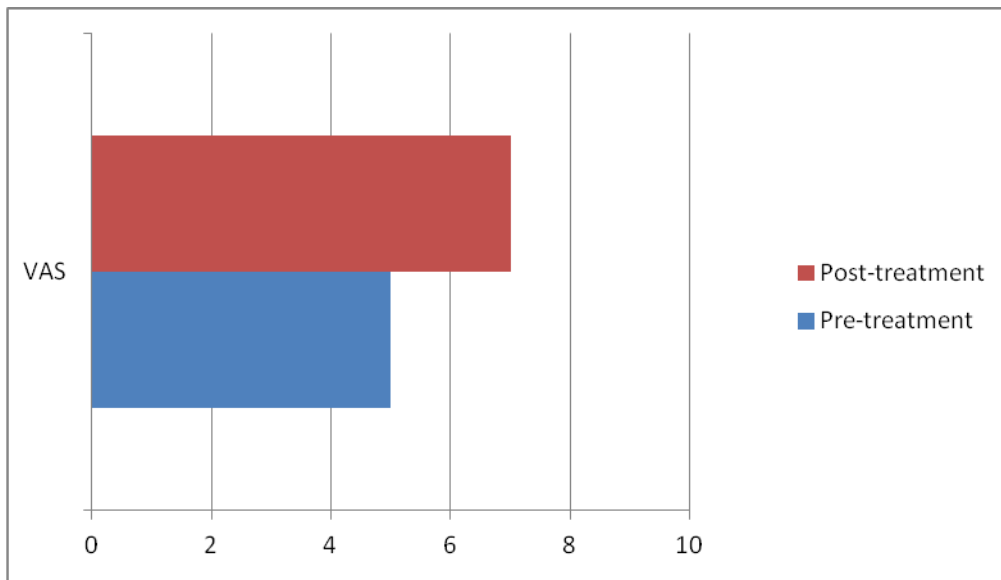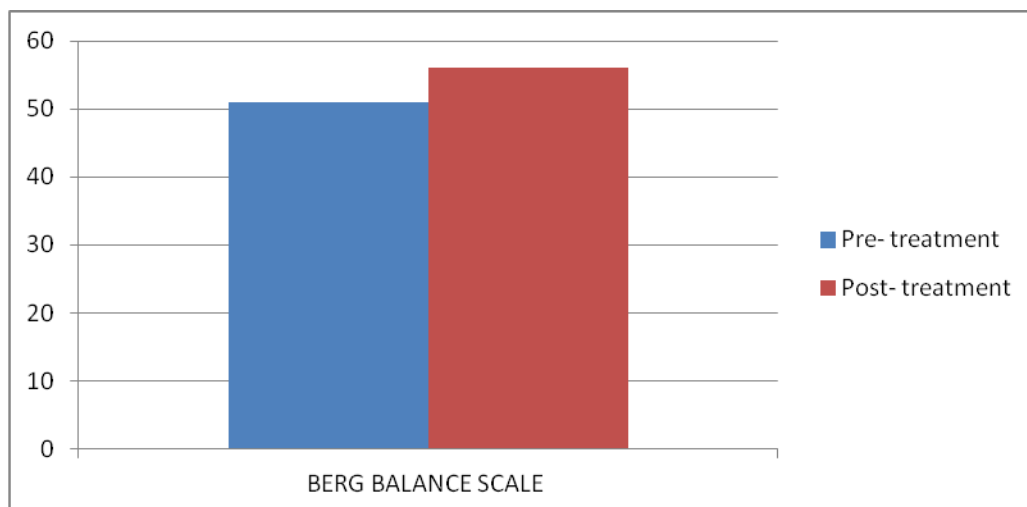
Figure 1. VAS findings prior to and after the treatment

2.2. ABC Findings

While the ABC score average was 60 at pre-treatment, it was achieved as 90 post-treatment. A 30% increase was achieved in the ABC score.

2.3. BBS Findings

While the BBS was 51 at pre-treatment, it went up to 56 post-treatment (Figure 2). A 9.8% increase was achieved in the BBS score.

Figure 2. BBS findings

3. Discussion

As a result of our study in which we applied balance training with the contribution of virtual reality as a visual stimulant, it was observed that balance training done with virtual reality has a healing effect on the vestibular system and that it decreased the symptoms of our patient who had vertigo/imbalance complaints due to bilateral peripheral vestibulopathy.

Controlled studies done on humans recently have shown that vestibular rehabilitation techniques are beneficial on patients with unilateral or bilateral vestibular loss [4].

In [5], a game system was developed using virtual reality technology for patients receiving physical therapy and rehabilitation treatment. A positive development was viewed in the patients. The most important aspect of the system was developing the patients' muscles while they were playing the game without getting bored and losing their motivation and the treatment gave results within a shorter period of time. It has also been stated that it is a suitable treatment method in terms of cost. It is a treatment style in which balance training has positive effects on the vestibular system through the virtual reality system.

A study carried out by Meldrum et al. [6] measured the usability of virtual reality as a treatment for balance disorder and they stated that besides its usability level being high, it had no side effects. They also stated that virtual reality might help physiotherapists' balance rehabilitation programmes.

Pavlou et al. [7] stated that integration of mixed visual environments with the treatment programme is more effective compared to an individual programme or only Cawthorne Cooksey exercises.

Gil-Gomez et al. [8] created a system to develop static balance through motivational and adaptive exercises in patients with brain damage called 'eBaViR' (easy balance virtual rehabilitation). The results of the study which involved 17 patients showed that this system is a reliable and effective method to develop static balance in patients with brain damage. Gil-Gomez et al. [8] stated that this study encourages consolidating virtual treatments with new exercises.

Sugraman [9], in their study involving an 86-year-old patient who had had a stroke, applied exercise periods which involved four different games through the Wii Fit system in addition to the standard treatment approach for balance training. While the patient used the quite enjoyable system during exercises, he did not experience any discomfort such as nausea or balance loss. After the standard treatment combined with the Wii Fit system, an improvement in the patient's antero-posterior balance and an increase in the 'timed up and go test' score was observed. When the patient was discharged from the hospital, he was able to walk with the help of a walker with minimal supervision. Based on this, Sugraman [9] stated that the virtual reality system was efficient enough to be used in clinics to develop balance.

In Canada, a study carried out by Bisson et al. [10] involved the application of biofeedback exercises with virtual reality on elderly individuals to determine its effect on functional balance and reaction time and as a result of the study, a significant increase was achieved in the reaction time and balance and mobility scores.

Vierre and Sitarz [3] stated that the use of virtual reality causes increase in vestibulo-ocular reflex gain and provides faster recovery.

Balance training carried out using the virtual reality system in patients with bilateral peripheral vestibulopathy is quite effective. The virtual reality application is an enjoyable and effective method of rehabilitation, which keeps the patient's motivation high throughout the treatment, besides having no side effects.

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