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The Effect of Using Virtual Reality Goggles on Balance

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Abstract

Aim: The aim of the study is to observe the long-term effects of using virtual reality goggles on balance on sedentary individuals.
Methods: A total of 28 sedentary male participants who voluntarily participated in the study were randomly divided into two groups. There are 14 participants in group was chosen as the experimental virtual realty goggles and the other 14 participants group as the control group non-virtual realty goggles. Groups did general strength training 3 days a week for 8 weeks. However, the virtual realty goggles group also did a 15-minute virtual realty goggles workout at the end of each workout training. In order to investigate the differences in balance performances of both groups, a pre-test was conducted and then a post-test was conducted 8 weeks later. In our study, y-balance test was preferred to measure dynamic balance and flamingo balance test was preferred to measure static balance. Paired simple t-test was used to compare the pre-test and post-test of the groups.
Results: In addition to strength tarining, virtual realty goggles group, revealed a significant difference in the dynamic balance values of the individuals ($p<0.05$). Although the 8 week strength training by the non-virtual realty goggles group had a positive effect on the dynamic and static balance performances of the participants, no significant difference was found ($p>0.05$).
Conclusion: The eight-week virtual reality goggles using that the sedantery indivuals will do in addition to their training increase dynamic balance.

Keywords

Virtual Reality Goggles
Dynamic Balance,
Static Balance,
Y-Balance,
Flamingo Balance.

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Sanal Gerçeklik Gözlüğü Kullanımının Dengeye Etkisi

Özet

Amaç: Düzenli spor yapan sedanter bireylerde sanal gerçeklik gözlüğü kullanımının denge performansına etkisini belirlemektir.
Metot: Gönüllü olarak düzenli spor yapan 28 erkek sedanter random olarak iki gruba ayrılmıştır. On dört katılımcı sanal gerçeklik gözlüğü kullanarak, diğer 14 katılımcı sanal gerçeklik gözlüğü kullanmayarak kontrol grubunu oluşturmuştur. Her iki grup 8 hafta süresince haftada 3 gün kuvvet antrenmanı yapmışlardır. Sanal gerçeklik gözlüğü kullanan grup her antrenmanın sonunda 15 dk sanal gerçeklik gözlüğü kullanmıştır. Her iki grubun dengeleri arasındaki farkı belirlemek için 8 haftalık antrenmanlardan önce ön-test ve sonrasında son-test uygulanmıştır. Dinamik dengeyi ölçmek için y-denge, static dengeyi ölçmek için flamingo denge testi kullanılmıştır. Grupların ön ve son testlerinin karşılaştırılmasında bağımlı gruplarda t test kullanılmıştır.
Bulgular: Genel kuvvet antrenmanlarına ek olarak, sanal gerçeklik gözlüğünü her antrenman sonrasında 15 dakika kullanan sedanterlerin dinamik dengeleri artmıştır ($p<0,05$). Sanal gerçeklik gözlüğü kullanmayan kontrolgrubunun ise dinamik ve statik dengelerinde değişim olmamıştır ($p>0,05$).
Sonuç: Sedanter bireylerin antrenmanlarına ek olarak yapacakları sekiz haftalık sanal gerçeklik gözlüğünü egzersizleri dinamik dengeyi arttırmıştır.

Anahtar kelimeler

Sanal Gerçeklik Gözlüğü,
Dinamik Denge,
Statik Denge,
Y-Balance,
Filamingo Denge.

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INTRODUCTION

Balance, in it's simplest definition, is the mechanism of realizing mobility by maintaining the bodys center of gravity (Emery, 2005). Although balance is thought of as a static concept, it is a dynamic process that includes many neurophysiological processes (Howe et al., 2011; Mckeon et al., 2008; Gonçalves et al., 2009). Balance is divided into two; the type of balance in which the acting forces are equal to each other is called static balance and the ability to move without falling and losing the general body posture is called dynamic balance (Hotchkiss et al., 2004). Just like other motor skills, balance is of great importance for the quality of life of individuals. The reason for this is that individuals with good balance are protected from negativities such as falling and injuries in daily life. In addition, balance is of vital importance for individuals who use vehicles where balance is important, such as bicycles and

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motorcycles, in daily life. There are various methods to measure balance. In our study, flamingo balance test was preferred to measure static balance, y-balance test was preferred to measure dynamic balance.

Star excursion balance test is another test in which dynamic balance is measured (Bressel et al., 2007; Olmsted et al., 2002). Since the star excursion balance test is a more detailed test in which 8-direction movements are performed, a simpler and 3-way movement test was needed in studies in this area over time. As a result, y-balance test was used, which was concluded to have advantages in terms of time management and efficiency (Kinzey et al., 1998; Plisky et al., 2009). On the other hand, flamingo balance test is a low-cost test that answer the requirements in studies with a high number of participants and measures static balance (Bakhtiari, 2012; Gokdemir et al., 2012).

Virtual reality goggles allow users to experience a computer-simulated reality enhanced by auditory, tactile and olfactory interactions (Li et al., 2011). There are studies that have found that balance can improve in a simulated reality (Cho et al., 2012; Kim et al., 2009; Singh et al., 2012; Yang et al., 2016). The decrease in the cost of virtual reality goggles and the fact that they are a technology that can be used by individuals from all walks of life paved the way for their scientific studies. Scientific publications based on virtual reality, including work on balance development, have created good opportunities. Of course, the most important issue here is how well the individual using the virtual reality goggles can adapt to the virtual environment and how individuals can integrate with the environment.

Y-balance and flamingo balance test included in the study is important in terms of standardization of measurements. As a result of the further development of technology, the integration between the user and the device in virtual reality goggles will reach a very high level. With this high level of relationship, possible changes in classical training methods are predicted.

The aim of the study is to observe the long-term effects training on balance ability of virtual reality use on sedentary individuals.

METHODS

Participants

A total of 28 sedentary male participants who voluntarily participated in the study were randomly divided into two groups. One group was chosen as the experimental **virtual realty goggles** (VR) and the other group as the control group non-**virtual realty goggles** (NON-VR). There are 14 participants in group VR and 14 participants in group NON-VR. Ethics committee approval for the study was obtained from the Clinical Research Ethics Committee of University Faculty of Medicine with the protocol code of 09.2020.513 in accordance with the Declaration of Helsinki Principles. The study was conducted with the understanding and written consent of each participant.

Procedures

Both groups did general strength training 3 days a week for 8 weeks. However, the VR group also did a 15-minute VR workout at the end of each workout. In the studies, the Samsung Gear VR SM-R323 Virtual Reality Glasses and the Samsung S6 Edge smartphone integrated with this device were used. In addition, the Be Fearless application was used for a positive effect on balance performance in virtual reality glasses. Age and height data were used by self-report and electronic scales (Tanita-MC-780) were used to measure body weight. Right and left leg lengths were measured using a tape measure. In order to investigate the difference in balance performance of both groups, a pre-test was conducted and then a post-test was conducted 8 weeks later. Y-balance test was preferred to measure dynamic balance and flamingo balance test was preferred to measure static balance. 13:00 (local time in Turkey/Istanbul) was chosen as the starting time for pre-test and post-test measurements.

Y-Balance Test

Y-balance test was used to measure dynamic balance. The y-balance test can be used to measure performance programs and rehabilitation progress. It can also be used for returning to sports after injury. The test was applied on the dominant and non-dominant extremities of the participants. The participants used the y-balance device, which was prepared in the dimensions specified in the literature, fixed on the board with a length of 35 cm, a width of 13 cm and a height of 4 cm. On the y-balance device, the amount of extension of the right and left extremities was measured. The validity and reliability rate of

the test was determined as 0.85 (Plisky et al., 2009). The y-balance score was calculated by taking the sum of 3 reach directions divided by 3 times the limb length and then multiplied by 100.

Flamingo Balance Test

Flamingo balance test was preferred to measure static balance. The test was applied on the dominant and non-dominant extremities of the participants. It was recorded how many times the participants fell in 1 minute while trying to balance on a 15 cm long and 4 cm wide wooden plate prepared in the dimensions specified in the literature. The validity and reliability rate of the test was determined as 0.71 (Tsigilis et al., 2002).

Statistical Analysis

Y-balance test and flamingo balance test pre-test and post-test data of the participants were compared. The data were analyzed using the SPSS (Statistical Package for Social Sciences) Windows 24.0 program. The compliance of the variables to the normal distribution was evaluated using the shapiro-wilk test. Paired simple t-test was used to compare the pre-test and post-test of the groups. Independent simple t-test analysis was used for comparisons between groups. The researchers assessed the findings at the $p<0.05$ significance level.

RESULTS

In our study, the use of virtual reality was determined as the independent variable, and the measured dynamic and static balance were determined as the dependent variable. The independent variable, the use of virtual reality, was determined randomly. Dynamic and static balance tests, which are dependent variables, are applied to both groups as standard.

Table 1. Participants values

	VR (n=14) (Mean±Std.)	NON-VR (n=14) (Mean±Std.)
Age	27.85±3.91	29.35±5.35
Height (cm)	173.71±6.14	173.85±9.10
Weight (kg)	73.80±10.02	75.94±17.24
Right leg length (cm)	86.07±4.26	88.35±6.62
Left leg length (cm)	86.07±4.26	88.35±6.62

Table 1 shows the descriptive statistics of the experimental group VR and the control group NON-VR.

Table 2. Group VR y-balance pre-test and post-test comparison values

	Pre-test (n=14) (Mean±Std.)	Post-test (n=14) (Mean±Std.)	p
Y-balance score right leg	80.85±7.55	84.54±7.25	**0.000****
Y-balance score left leg	81.60±6.28	83.78±6.21	**0.005****

p<0.01

In table 2, y-balance pre-test and post-test values of both sides of the VR group were compared. A significant difference was found between the pre-test and post-test values of both sides. As a result of the exercises performed with virtual reality glasses, it was observed that the dynamic balance performance of the participants increased($p<0.05$).

Table 3. Group VR flamingo balance pre-test and post-test comparison values

	Pre-test (n=14) (Mean±Std.)	Post-test (n=14) (Mean±Std.)	p
Flamingo right leg	3.35±1.78	3.00±2.00	0.404
Flamingo left leg	4.00±3.53	3.21±2.35	0.167

In table 3, the flamingo balance pre-test and post-tests of both sides of the VR group were compared. Although there was positive progress between the pre-test and post-test values of both sides, no significant difference was found ($p>0.05$).

Table 4. Group NON-VR Y-balance pre-post test comparison values

	Pre-test (n=14) (Mean±Std.)	Post-test (n=14) (Mean±Std.)	p
Y-balance score right leg	75.26±8.79	75.49±9.39	0.653
Y-balance score left leg	79.36±7.36	79.59±6.96	0.876

In table 4, y-balance pre-test and post-test values of both sides of the NON-VR group were compared. Although there was positive progress between the pre-test and post-test values of both sides, no significant difference was found (p>0.05).

Table 5. Group NON-VR flamingo balance pre-post test comparison values

	Pre-test (n=14) (Mean±Std.)	Post-test (n=14) (Mean±Std.)	p
Flamingo right leg	3.78±2.99	2.57±1.60	0.062
Flamingo left leg	5.71±4.73	4.92±3.75	0.181

In table 5, the flamingo balance pre-test and post-tests of both sides of the NON-VR group were compared. Although there was positive progress between the pre-test and post-test values of both sides, no significant difference was found (p>0.05).

DISCUSSION

With the increase in research on balance, which is a motor skill, balance has become one of the methods of improving physical performance in the field of sports (Yaggie & Campbell, 2006; Richardson & Melanie 2005). In addition, balance is extremely important as it increases the quality of life of individuals and contributes to their daily living activities more comfortably. For this reason, in our study, the effect of regular exercise using virtual reality glasses on balance performance was investigated. The first of our hypothesis; dynamic balance develops as a result of exercises performed with virtual reality. When we look at the data of our research, we see that our first hypothesis is positive. The reason for this is, that virtual reality exercises strengthen the stabilizer muscles in the body. Strengthened stabilizing muscles helped better dynamic balance performance. Our second hypothesis; static balance develops as a result of exercises performed with virtual reality glasses. When we look at the data of the research, we see that the second hypothesis was not realized. Because the "Be Fearless" application, which we use in virtual reality training, has a more effect on dynamic balance than static balance. For this reason, no significant difference was found in the experimental group flamingo balance test pre-test and post-test data.

Mao et al. show that virtual reality exercises can activate the cerebral cortex, making it easier for the cortex to control balance and increase movement function (Mao et al., 2014). Falls due to loss of balance cause serious injuries to individuals. In the study conducted by Singh et al. it was concluded that applying virtual reality exercises can increase balance confidence and reduce the risk of falling among women living in the community (Singh et al., 2012). In a 6 week study conducted by Cho et al. it was observed that individuals with chronic stroke who did 30 minutes of virtual reality exercise a day, 3 times a week, improved their balance performance. It has been found that virtual reality exercises are applicable for chronic stroke patients with balance deficits in clinical settings (Cho et al., 2012). The fact that virtual reality exercises are easy to apply has made it simple for different populations to exercise using this method. In the study conducted by Cho et al. it was concluded 8 weeks, 3 days a week, 30 minutes a day virtual reality exercises applied to elderly adults aged 65-80 can be effective in improving the balance of healthy elderly adults and can be recommended as a fall prevention exercise for the elderly (Cho et al., 2014). On the other hand, Rendon et al. observed an increase in balance performance of older adults who performed virtual reality exercises 3 days a week for 6 weeks compared to the control group (Rendon et al., 2012).

Children with Down syndrome have more difficulty in maintaining their body balance than other children. However, this situation can be overcome with virtual reality exercises. Rahman et al. observed that there was a significant improvement in the balance performance of children with Down syndrome who did virtual reality exercises for 6 weeks (Rahman et al. 2010). Brien et al. concluded that intense virtual reality exercises for 90 minutes daily for 5 consecutive days had a positive effect on the

development of functional balance in adolescents with cerebral palsy (Brien & Sveistrup., 2011). As seen in previous studies, virtual reality balance exercises have shown positive effects in older adults, chronic stroke patients, individuals with Down syndrome and individuals with cerebral palsy. The effect of virtual reality exercises on balance is observed not only in the clinical field but also in the field of sports sciences. In the study conducted by Donohue et al. female athletes performed virtual reality exercises for 8 weeks, 3 days a week, 7 minutes a day. At the end of the study, it was revealed that there was a significant improvement in the dynamic balance of female athletes who did virtual reality exercises (Donohue et al., 2018). Ranjbarzadeh et al. investigated the effect of 8 weeks of virtual reality training on static and dynamic balance and performance in male athletes with functional ankle instability. As a result of the 8 week and total 24 exercise programs, it was revealed that the balance performance of men with functional ankle instability improved significantly (Ranjbarzadeh et al., 2021).

CONCLUSION

In addition to general strength exercises, virtual reality exercises for 15 minutes a day, 3 days a week by the experimental group (VR) for 8 weeks, revealed a significant difference in the dynamic and static balance values of the individuals. Although the 8 week general strength exercises performed by the control group (NON-VR) had a positive effect on the static and dynamic balance performances of the participants, no significant difference was found. The reason why there was a significant difference in the dynamic balance pre-test and post-test data in the experimental group is, because virtual reality exercises strengthen the stabilizing muscles in the body of the participants in the experimental group. For this reason, the balance performance of the participants increased. It is predicted that virtual reality training in different populations and in sports branches where balance skills are important, can have a positive effect on dynamic balance.

PRACTICAL APPLICATIONS

In our study, the positive effect of virtual reality exercises on balance was revealed. It is recommended that the trainers who are interested in sports branches where balance is important, should pay attention to the results of our study. It is suggested that they try the new approach to training sciences. In this way, athletes can increase their performance, achieve better grades and accelerate their development.

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