The effect of Augmented Reality-Based Proprioceptive Training Program on Balance

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증강현실 기반의 고유수용성 운동이 균형에 미치는 영향

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Abstract

Background/Objectives: This study investigates whether AR-based interventions can be as effective as physical therapists regarding balance, positioning sensation, and flexibility.

Methods/Statistical analysis: A sample of 39 regular people who voluntarily participated in this study were randomly distributed into two groups. Then AR and PT-based interventions were respectively applied to each group. All measurements were analyzed using paired t-test and independent t-test.

Findings: The exercise program of this study improved the ST of the static balance in both groups after the intervention, and the p-value was less than $0.05(p<.05)$ at NC and PC positions. In addition, regarding the case of dynamic balance, the p-values of AR and PT groups for reaching in all directions were less than $0.05(p<.05)$. In the case of positioning sensation, the p-value was greater than $0.05(p>.05)$ in both groups, and the flexibility was less than $0.05(p<.05)$.

Improvements/Applications: The study was limited since the subjects were healthy normal people in their 20s and it is difficult to generalize other age groups based on the results on this study.

Keywords: Augmented Reality, proprioceptive exercise, balance, positioning sensation, flexibility

1. Introduction

Augmented reality (AR) is a computer graphics technique that superimposes digital components (virtual environments) to look like they are in the original environment. However, unlike Virtual reality (VR), it is not isolated from the real world because it exists and interacts in space-time like reality. In addition, the development of science technology such as devices and software has made reality and virtual reality and interaction with users more natural. As a result, research on AR is increasing year by year, and it has had a more significant impact on society as a whole, including consumers and companies, in various fields such as education, marketing, games, and medical care [1]. Therefore, the purpose of this study is to investigate the effects of balance, position sense, flexibility, and AR when an AR-based proprioceptive exercise program uses Swiss Ball.

2. Material and Methods

2.1 Experimental procedure

The research procedure is as follows [Figure 1]. All subjects were randomly divided into augmented reality-based proprioceptive exercise group (ARPE) and proprioceptive exercise group (PTPE) conducted by physical therapists. All subjects were measured twice before and after intervention for static balance, dynamic balance, leg length, positioning sensation, and flexibility. The Proprioceptive exercise program lasts four weeks and lasts two days and 35 minutes a week. In the first two weeks, two sets were repeated ten times, and three sets were repeated twelve times for the rest of the week. The Swiss Ball used for

intervention was provided in 55-65cm sizes depending on the target's height and was carried out barefoot. (figure 1)
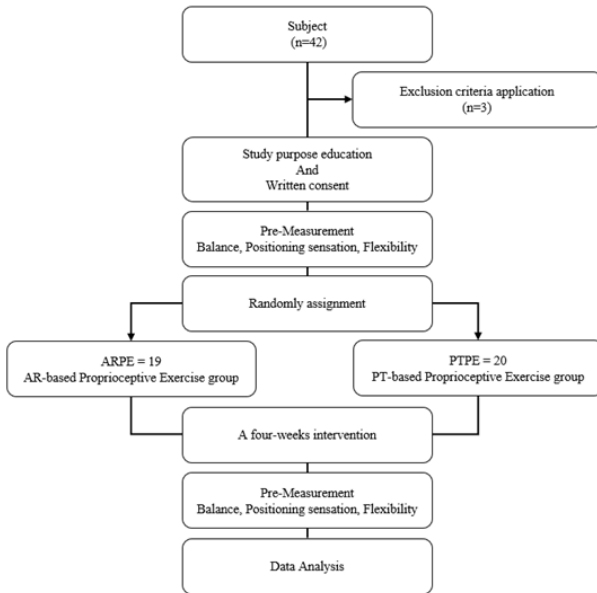

Figure 1. experimental procedure

2.2. Data Analysis

In this study, descriptive statistics were used to evaluate general characteristics, and the mean (M) and standard deviation (SD) of each variable were calculated. All statistical analyses used 'IBM SPSS 20.0 Statistical Software'. Paired t-test was used for pre-post variables within each group, and Independent t-test was used to compare the results between the two groups. The statistical significance level was set to α=0.05.

3. Results

As a result of pre-measurement of static balance using Tetrax, there was no significant difference between groups in ST(stable index('s and WDI(weight distribution index)'s NO(eye open), NC(eye closed), PO(pillow eye open), PC(pillow eye closed)(p>.05). As a result of pre-post measurement of each group after application of intervention, there was no significant difference in all postures of WDI, NO, PO of ST in both groups(p>.05), but There was a significant difference between ST's PC and NC(p<.05). And post-measurement between the two groups, there was no significant difference(p>.05)

4. Discussion

People with impaired static balance depend more on proprioception than those without them. Proprioceptive exercise is essential in rehabilitation because it improves proprioception by properly designed exercise and training programs. Training tools such as balance boards, BOSUs, and Swiss balls have usually been used to improve balance. Not only the existing training tools but also augmented reality (AR)-based research is being actively conducted. Im et al. (2015) announced that the four-week AR exercise program for the elderly showed significant improvements in lower extremity function and balance, reducing the risk of falling [2]. This suggests that AR alone can achieve a balance effect without the therapist's supervision in general exercise therapy. This study also confirmed that there is no significant difference between the two groups. In the case of regular people, it is difficult to identify differences in effects without external stimuli, but changes in the environment, such as blocking vision and unstable support, further increase the dependence on the proprioception. Hebner. (2021) identified changes in cortical area activity related to proprioceptive sensation under various conditions of standing balance control [23]. This proves that the presence of vision may affect the experiment results and confirms that NC and PC ST have improved in this study.

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