Investigation of the Effectiveness of TecnoBody Devices in Rehabilitation

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Abstract

With the advancement of technology, the effect of auxiliary machines used in rehabilitation is gradually increasing both in the evaluation stage and the rehabilitation stage of the treatment. The important feature of such devices is that they perform both assessment and treatment with the same device. At this stage, TecnoBody (Bergamo, Italy) devices play an active role in both assessment and rehabilitation. In this study, the effectiveness of TecnoBody devices, D-Wall, Walker View 3.0 SCX, and ProKin devices in rehabilitation was analyzed. It is reported in the literature that recently TecnoBody devices have been used significantly in evaluation, proprioceptive and stability tests have been performed with ProKin devices, and balance tests have been performed with the D-Wall device. The D-Wall device was found to be effective in therapies due to its use in rehabilitation, exergame, and biofeedback. It is observed that the Walker View 3.0 SCX device is effective in gait analysis evaluation and gait rehabilitation after surgery, while ProKin devices are effective primarily in proprioceptive, stability, and balance evaluations and then in balance and proprioceptive training. The use of TecnoBody devices in rehabilitation increases the active participation of people in therapy thanks to the visual biofeedback it applies to people, it is effective thanks to the fact that people can direct themselves during exercise and make therapy more fun with games. In addition, thanks to the personalized exercises in the D-Wall device, there are effective exercises to increase the participation of people in daily life activities, especially in neurological rehabilitation. Therefore, the use of TecnoBody devices in rehabilitation is effective.

Keywords: Rehabilitation technologies, rehabilitation, virtual reality.

Rehabilitasyonda TecnoBody Cihazlarının Etkinliğinin İncelenmesi

Öz

Rehabilitasyonda kullanılan, yardımcı makinelerin, teknoloji ilerlemesi ile tedavinin hem değerlendirme aşamasında hem de rehabilitasyon aşamasında etkisi giderek artmaktadır. Bu tür cihazları önemli özelliği ise hem değerlendirmeyi hem de tedaviyi aynı cihazla yapmaktadır. Bu aşamada TecnoBody (Bergamo, İtalya) cihazları, hem değerlendirmede hem de rehabilitasyonda aktif rol oynamaktadır. Bu çalışmada

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TecnoBody cihazlarından, D-Wall Elite, Walker View 3.0 SCX ve ProKin cihazlarının rehabilitasyonda etkinliği incelenmiştir. Literatürde, son zamanlarda TecnoBody cihazları değerlendirmede önemli ölçüde kullanıldığı, ProKin cihazları ile proprioseptif ve stabilite testlerinin uygulandığı ve D-Wall cihazı ile denge testleri yapıldığı bildirilmektedir. D-Wall cihazının rehabilitasyonda, exergame ve biofeedback olarak kullanılması sonucu terapilerde etkili olduğu görülmektedir. Walker View 3.0 SCX cihazının ise cerrahi sonrasında kişileri yürüme analizi değerlendirmesinde ve yürüme rehabilitasyonlarında etkili olduğu, ProKin cihazlarının ise öncelikle proprioseptif, stabilite ve denge değerlendirmelerinde ve sonrasında denge ve proprioseptif eğitimlerde etkisinin olduğu görülmektedir. TecnoBody cihazlarının rehabilitasyonda kullanılması, kişilere uyguladığı vizüel biofeedback sayesinde kişileri terapiye aktif katılımını arttırmakta, kişilerin egzersiz sırasında kendilerini yönlendirmesi ve oyunlarla terapiyi daha eğlenceli hale getirmesi sayesinde etkili olmaktadır. Ayrıca D-Wall cihazında kişiselleştirilmiş egzersizler sayesinde özellikle nörolojik rehabilitasyonda kişileri günlük yaşam aktivite katılımlarını arttırmak için etkili egzersizler bulunmaktadır. Bu nedenle TecnoBody cihazlarının rehabilitasyonda kullanımı etkilidir.

Anahtar Sözcükler: Rehabilitasyon teknolojileri, rehabilitasyon, sanal gerçeklik.

Introduction

Various assistive technologies are widely used in exercise and rehabilitation in various ways. Starting 20 years ago, with video game consoles (Nintendo, Wii Fit and Xbox Kinect etc.), rehabilitation of people in a virtual reality environment has started to be performed during the whole body game. Such rehabilitative games are called exergames[1]. One of the most widely used alternative therapies today is exergame training/active video game-based therapies. Exergame consists of a series of cognitive and motor tasks interacting with users in real time with biofeedback technology (e.g. virtual reality, step-mat, sensor)[2]. Exergame aims to motivate people during rehabilitation, reduce the frequency of the rehabilitation process, increase the motivation of patients, enable dual-task training, increase participation and support the rehabilitation of people with feedback[3-7]. Compared to traditional physiotherapy, the biofeedback technology (e.g. virtual reality) in exergame enables the intervention to be completed more comfortably by enabling different types of training environments and task protocols to be created when necessary; and this technology provides real-time biofeedback that allows users to adjust their movements or body movements during training[8,9].

In the field of physiotherapy and rehabilitation, the assessment of patients is often difficult or subjective. However, thanks to the developing technology, video-based evaluations of the range of motion of individuals, evaluation and rehabilitation during exergame are increasing. In addition, with the developing rehabilitation technologies, the balance parameters of individuals are evaluated in virtual reality (VR) environment

and then rehabilitation is applied with biofeedback applications combined with exergame and VR. In the field of physiotherapy and rehabilitation, devices that objectively evaluate patients and then treat patients with exergame are emerging. One of these devices is the devices developed by TecnoBody company. Our aim in this article is to examine the effectiveness of the rehabilitation devices developed by TecnoBody company.

TecnoBody Devices in Rehabilitation

TecnoBody, D-Wall is an assessment and rehabilitation device for improving movement quality with auditory and visual feedback support. This device is effectively used both in rehabilitation processes and in adapted physical activities. D-Wall, which is widely used especially in the field of sports sciences, offers assessment and training in different mobility and aerobic training modes. The main areas of use of D-Wall are; assessment and training in different mobility and aerobic training modes in sports sciences, postural structure-specific assessment and training during movement, assessment and training of segmental and global coordination and sensory-motor skills, assessment and training for correction of joint dysmetries/asymmetries, and determination of the degrees and biomotor values of joints during movement kinematics, focusing on the head, trunk, shoulders, hips and knees[10].

The D-Wall instantly recognizes every movement performed in the operational area using a 3-dimensional (3D) camera and force platform and can identify every movement up to 16 body joints (Figure 1.). Physiotherapists and sports specialists use this device to improve functionality in athletes, especially in orthopedic, neurological and geriatric individuals[10].

Walker View 3.0 SCX is a treadmill with a 3D motion capture camera and a sensing surface with 8 load cells (Figure 2.)[11]. This system is equipped with sensors that offer the ability to perform posture and gait analysis in a short period (at least 30 seconds)[12]. The Walker View system can be used in daily clinical practice due to the speed and ease of gait analysis reporting. Clinicians and physiotherapists can quickly assess gait spatiotemporal parameters and information on the total range of motion with objective data from Walker View 3.0 SCX.

Figure 1. Neurorehabilitation on the TecnoBody D-Wall device[13,14].

Walker View can also be used to analyse asymmetries and changes in total range of motion and is comparable to gold standard systems that require further investigation to identify trends in abnormal kinematic parameters[10]. Since the evaluation of supports and joint degrees during gait is reported, there is the possibility to plan gait training with the Gait Trainer. The Gait Trainer aims to independently correct the patient's motor pattern during walking or running movements[13].

Prokin is an advanced technology that combines a platform, a monitor and a loudspeaker (Figure 3.). This system responds to minimal movements performed by the patient with visual and auditory feedback. The feedback reflected from a screen controlled by the patient is analysed and integrated by special software. This integration helps to understand proprioceptive disorders more clearly and to create targeted rehabilitation pathways, with movements focussed specifically on the ankle joint[14].

The Prokin device evaluates people's balance statically and dynamically. Then, balance exercises are performed by creating personalized exercise programs. Balance is assessed by static, monopedal dynamic with controlled load, bipedal dynamic and trunk control. Prokin is designed as a mobile balance platform powered by air piston servo motors. The automatic motor locking function allows the system to quickly switch from dynamic to static measurement. Furthermore, the dynamic control system automatically adjusts the balance of the moving platform according to the weight of the person and the coefficient of instability[15,16].

Figure 2. Walker View 3.0 SCX gait rehabilitation study[11].

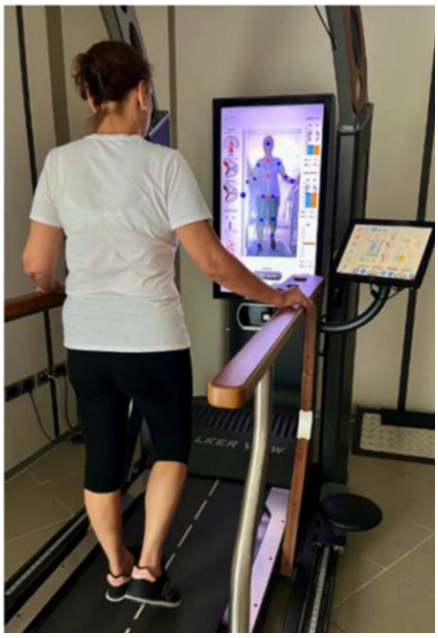

Figure 3. TecnoBody Prokin device[17]

Investigation of the Effectiveness of TecnoBody Devices

In a study, a 40-year-old woman with chronic spinal cord injury (SCI) with T5 level complete ASIA A score was included in the study. In the study, range of motion (ROM) and trunk loading were evaluated with D-Wall device. The study aimed to improve the activities of daily living of a person with chronic SCI and to use VR to improve the rehabilitation programme. In addition to the patient's rehabilitation, one day a week was

added to the work programme with the D-Wall device. In the study with D-Wall device, 19 different exercises consisting of joint mobility exercises, strengthening exercises, proprioception exercises, loading exercises and occupational exercises were performed in a wheelchair. As a result of the study, it was found that the integration of the D-Wall device into the rehabilitation programme was beneficial for the patient. In the evaluation of the patient with the D-Wall device, an increase in active participation in the rehabilitation process was observed, thanks to the patient's instant objective view of his/her own functional evaluation. During the exercise with D-Wall device, the results of each movement were seen objectively and instantaneously, allowing the patient to get maximum efficiency from the exercises. In conclusion, the integration of the D-Wall device into conventional rehabilitation increases the active participation of the person in the treatment. However, it is reported that the study should be conducted with a larger research group[18].

In a study, 60 people over the age of 60 (mean age 62±3 years) who had Covid-19 were included in the study. Participants were divided into two groups. The control group received traditional physiotherapy and the intervention group received D-Wall device in addition to traditional physiotherapy. The study aimed to improve the functional abilities and endurance of people with persistent COVID-19 symptoms to normal values. In the study, the 6-minute walk test (6MWT) was applied. Therapies were applied to people 2-3 days a week, 1 hour a day for a total of 10 sessions. As a result of the study, a statistically significant difference was observed in both groups. However, a study with more participants is needed[19].

In a different study, the initial findings of the relationship between jumping and tensiomyography against lower extremity muscle asymmetries in male football players were analyzed. Two of the 25 male football players who volunteered to participate in the study were excluded due to ongoing injuries; therefore, 23 participants (18 ± 4 years, age range 16-27 years) were included in the final analysis. In the evaluation, D-Wall device was used for the vertical jump. In the evaluation, jumps were taken three times, and the highest data were taken. Video analysis of the football players participating in the study supported the standardization of their positions before and during the jump, while jump parameters were collected during the strength platform jump. As a result of the study, it was found that the combination of vertical jump and tensiomyography assessment may provide more useful information by identifying different components (i.e. dynamic and

"controlled" muscle contraction characteristics) that may be involved in sport-specific tasks[20].

In a study conducted in the United Arab Emirates, the effect of badminton on cardiovascular and neuromuscular functions in older adults was examined. 120 people participated in the study. Participants were equally divided into three different groups. The study lasted 8 weeks. In the evaluation, cardiovascular and neuromuscular components were evaluated primarily. Secondarily, it was evaluated with Tecnobody devices. Muscle peak strength was analyzed for quadriceps and hamstring muscles using TecnoBody ISOMOVE isokinetic device. Proprioception was evaluated using TecnoBody ProKin 252 device, and bipedal and unipedal balance, reaction time and hand-eye coordination were evaluated using TecnoBody D-Wall device. As a result of the study, it was observed that cardiovascular and neuromuscular functions improved in all groups of older adults during badminton sport[21].

In a study conducted in China, 104 people were included in the study. The participants were divided into a control group (n=52) and an intervention group (n=52). While classical physiotherapy was applied to the control group, classical physiotherapy and ProKin device were applied to the intervention group. The study lasted 8 weeks. Lysholm test, Tinetti test and ProKin device were used in the evaluation. As a result of the study, a significant improvement in weight transfer was observed in the intervention group[22]. In another study, it was aimed to show the effectiveness of physical therapy in the treatment of neuromyelitis optica. In the study, a 13-year-old female patient with symptoms of left-sided weakness, balance and gait disturbances underwent a 2-week exercise protocol including progressive resistance training for strengthening, exergame with D-Wall device for balance and stability improvement and modified restraint. She was assessed by manual muscle testing, ProKin device, Functional Independence Assessment (FIM) and upper extremity abilities Questionnaire for Activities of Daily Living (CUE-Q). It was applied to the person 5 days a week for 2 weeks. As a result of the study, no significant difference was observed in manual muscle testing. However, a significant increase was found in balance parameters[23]. In another study, 40 people were included. The subjects were divided into 20 people with low back pain (64.90±3.33 years) and 20 healthy people (63.20±2.33 years). In the evaluation, the postural assessment was performed with the TecnoBody ProKin254P with eyes open, eyes closed, and on one leg. In the study, no significant difference was found in sway length (mm),

sway area (mm²), anteroposterior velocity (mm/s) and central of pressure (COP) parameters including mediolateral[24].

In another study, the effect of poor sleep quality on physical activity level, postural stability and isometric muscle strength in adolescent children was investigated. A total of 62 subjects were included in the study, 31 with normal sleep quality and 31 with poor sleep quality. The postural stability of the subjects was evaluated with ProKin device. As a result of the study, it was found that people with poor sleep quality had a significant decrease in postural stability with eyes open and closed compared to people with normal sleep quality[25].

In a study, 40 people with total knee arthroplasty were included in the study. The subjects were divided into two groups as control group (n=20) and intervention group (n=20). While the control group received classical physiotherapy, the intervention group received gait training with feedback system with Walker View 3.0 SCX and proprioceptive-stabilometric training with ProKin 252 device in addition to classical physiotherapy. The study was conducted for 6 weeks, 5 days a week, 2 sessions per day and 1 hour per session. Numerical Pain Scale was used for pain, Barthel Index for activities of daily living, ProKin 252 device for proprioceptive-stabilometric evaluation and G-WALK device for quantitative evaluation of gait parameters. As a result of the study, a significant difference was found in gait parameters, kinematic values and motor performance of the intervention group compared to the control group. As a result, it was found that compared to traditional rehabilitation, telerehabilitation makes the person more active during therapy, involves the person in the therapy with feedback and teaches motor control[11].

In the study, 30 runners were included. The runners were divided into two groups as heel strike peak pressure affected (n=16) and heel strike peak pressure unaffected (n=14). They were evaluated with TecnoBody Walker View 3.0 SCX device. Heel strike, spatiotemporal and kinematic parameters were evaluated. As a result of the study, it was observed that hip flexion, hip extension and dorsi flexion angles were decreased in subjects with unaffected peak pressure at heel strike compared to subjects with affected peak pressure at heel strike. In addition, it was found that there was a shortening in the stride length of those who were not affected by peak pressure in heel strike. In recreational runners, it has been observed that runners whose hip extension is close to 40°, foot dorsi flexion angle is close to 20°, and foot dorsi flexion angle is close to 14° at

first foot contact may have an effect on peak pressure at heel strike, which may trigger ankle injuries or lower extremity injuries[26].

In a different study, 68 elderly people (with a diagnosis of stroke or Parkinson's disease) were included in the study. The study was divided into two groups. The first group was the control group (n=34) and the second group was the intervention group (n=34). Functional foot mobility was assessed with TecnoBody ProKin device. The intervention group received tai chi exercises in addition to general physiotherapy. The study lasted 3 days a week, 40 minutes a day for 12 weeks. Tai chi exercises were found to affect postural stability. As a result of the study, tai chi exercises were found to affect chronic ankle injuries[15].

Conclusion

TecnoBody devices are effective in rehabilitation in terms of both evaluation and therapy. It is effective in rehabilitation thanks to biofeedback during exercise, keeping people in therapy, teaching motor control, increasing active participation by making therapies fun with games, providing personalized exercise design, and working on daily life activities. However, it is seen that its use in neurological rehabilitation needs more studies.

Recommendations

TecnoBody devices are effective in rehabilitation. With the addition of such devices to therapies, it is expected that the feedback from patients will increase. Such devices increase the active participation of people during the therapy, they are asked to self-correct with feedback and accelerate motor learning.

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