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Farklı Stabilite Özelliğine Sahip Rehabilitasyon Materyallerinin Kas Aktivasyonuna Etkisi: Derleme

Effects of Rehabilitation Materials With Different Stability Properties on Muscle Activity: A Narrative Review

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ÖZ

Fizyoterapi ve rehabilitasyon kliniklerine başvuran hastalarda önemli oranda kassal imbalans ve proprioseptif duyu bozukluğu görülmektedir. Bu bozuklukların restorasyonu amacıyla fizyoterapi kliniklerinde bosu, farklı sertlikteki denge araçları (stability trainer), denge tahtası, tedavi topları ve osilasyon cihazları kullanılmaktadır. Ancak bu terapi cihazlarının farklı kas gruplarındaki aktivasyonu nasıl değiştirdiği tam olarak bilinmemektedir. Bu çalışmanın amacı farklı stabilite özelliğine sahip terapi cihazlarının kassal aktivasyona etkisini araştırmaktır. Bu amaçla, Haziran 2021 tarihinde Medline (PubMed), Embase ve Cochrane Library veritabanları kullanılarak arama yapıldı. Farklı stabilite özelliğine sahip terapi cihazlarının kassal aktivasyona etkisini araştıran çalışmalar derlemeye dahil edildi. 7 çalışma içleme kriterlerini sağladı. Kullanılan zeminin stabilite özelliğinin ve sertlik düzeyinin değişmesi belirli kas gruplarında aktivasyon artışına neden olurken bazı kas gruplarının aktivasyonunda anlamlı değişikliğe neden olmamaktadır. Bu nedenle fizyoterapi ve rehabilitasyon kliniklerine başvuran hastaların tedavi programı belirlenirken hedef kas grubunun iyi belirlenmesi ve bu amaca uygun tedavi cihazlarının kullanılması önemlidir.

Anahtar Kelimeler: Kas aktivasyonu, Rehabilitasyon materyalleri, Propriosepsiyon.
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ABSTRACT

Significant muscle imbalance and proprioceptive sensory impairment are seen in patients who apply to physiotherapy and rehabilitation clinics. Bosu, balance tools of different hardness (stability trainer), balance board, treatment balls, and oscillation devices are used in physiotherapy clinics for the restoration of these disorders. However, it is not known exactly how these therapy devices change the activation in different muscles. The aim of this study is to examine the effect of therapy devices with different stability features on muscular activation. For this purpose, a search was performed using "Medline (PubMed), Embase, and Cochrane Library" databases in June 2021. Studies investigating the effect of rehabilitation material with different stability properties on muscular activation were included in the narrative review. 7 studies met inclusion criteria. The change in the stability and hardness level of the surface causes an increase in activation in certain muscle groups, while it does not cause a significant change in the activation of some muscle groups. For this reason, it is important to determine the target muscle group well and to use treatment devices suitable for this purpose when determining the treatment program of patients who apply to physiotherapy and rehabilitation clinics.

Key Words: Muscle activation, Rehabilitation materials, Proprioception.

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1. INTRODUCTION

The human foot is an important body part that provides interaction between the human body and the environment. The human foot is responsible for providing information to the central nervous system to speed up muscular responses during different tasks. A significant source of sensory feedback comes from special mechanoreceptors found within the skin of the foot (1). Stimulation of nerves that innervate the foot can affect motor neuron activity in the muscles of the lower extremity, most probably through A-Beta reflex pathways (2).

Proprioceptive and sensorimotor training exercises are important applications used in the treatment of injuries caused by muscular imbalance and proprioceptive sensory deficit (3, 4). Devices with different stability characteristics are frequently used to treat muscular imbalance and proprioceptive sensory deficit (5). Unstable mats, balance boards, stability trainers, oscillation devices, balls are examples of these devices (6,7). The use of these devices changes muscular activation (8). Watanabe et al. showed that standing on rehabilitation materials with different stability properties can alters the transmission of signals from the plantar surface of the foot. They also showed that it increased tibial nerve activation when standing on textured surface (9). Wu et al. demonstrated that atency of lower extremity muscle reflexes change when standing on soft grounds. So, sensory feedback coming from the feet was changed when standing on the different surfaces (10).

It is generally accepted that the training workload in physiotherapy programs should be increased over time (8). Generally, less stable therapy devices are known to cause a higher muscular activation (11). However, it is not known whether the rehabilitation program, which moves towards the use of less stable devices, increases muscular activation in all extremity muscles. The primary aim of this review is to provide maximum benefit from rehabilitation by compiling studies examining the effects of different surfaces on muscular activation. The secondary aim of this study is to help plan the rehabilitation program by examining how rehabilitation materials with different stability properties change the activation of lower extremity muscles.

2. METHOD

Literature Review

In this narrative review, a literature search was conducted in “Medline (PubMed), Embase, and the Cochrane Library” in July 2021 to identify effects of rehabilitation materials with different stability properties on muscle activity. Searches were made using “different stability property, training devices, muscle activation, and stability trainer” keywords. The articles were chosen by, first, reading the abstract, and subsequently data were analyzed by reading the entire text via full-text resources. To undertake the study, we have collected information published about effects of therapy devices with different stability properties on muscle activity over the last 17 years (2005-2021). According to our results, 7 randomized controlled studies met inclusion criteria.

3. RESULTS

Nurse et al. investigated the effect of smooth and textured materials placed in shoes on lower extremity muscle activation. For this purpose, 15 healthy volunteers were asked to walk at a certain speed with smooth and then textured shoe insert. Tibialis anterior and soleus muscle activation was examined with surface EMG (s-EMG). The textured shoe material caused an important reduction in both soleus and tibialis anterior activity during walking. This study showed that altered sensory input could have private effects on different motor neuron pools (1).

Harput et al. examined how muscular activation in the lower extremity changed during one-leg balancing and forward lunge exercises on two different balance materials (BOSU and Thera-Band Wobble Board). Peroneus longus, tibialis anterior, and medial part of gastrocnemius muscle activation were evaluated with superficial EMG during these exercises.Twenty four healthy sedentary individuals (12 females, 12 males) were included in the study. As a result of the study, it was shown that there was no difference on the effect of balance platform on muscular activation (12).

Wolburg et al. included 25 healthy volunteers to examine the effect of different hardness surfaces on muscle activation. (22 men, 3women). Participants were asked to balance on their dominant legs for 15 seconds on 5 surfaces of different hardness (Therapy Top, Thera Green, Thera Blue, Airex Mat and Thera Black). Electromyographic activity of four lower (soleus, medial gastrocnemius, peroneus longus, tibialis anterior) and four upper leg muscles (biceps femoris, vastus medialis, vastus lateralis, and semitendinosus) was evaluated by s-EMG. This study showed that as the stabilization of the therapy devices decreases, the activation of the medial gastrocnemius, soleus, peroneus longus and biceps femoris muscles increases (8).

Hugh et al. investigated the effect of running at different speeds (8 km/hour and 11 km/hour) and different surfaces on muscular activation. Eight well-trained male athletes were included in the study. Participants were asked to run at different speeds on firm surface (carpeted wooden floor) and soft sand. During running, activation of the rectus femoris, semimembranosus, biceps femoris, tensor fascia latae vastus lateralis and medialis, muscles was evaluated with superficial EMG. During step phase, activation of semimembranosus and biceps femoris muscle was greater running on sand compared with the firm surface at 8 km/hour and 11 km/hour. During the stance phase in the 8 km/hour trials, electromyographic activity in the hamstrings, vastus lateralis and vastus medialis, rectus femoris and tensor fascia latae muscles were greater than the firm surface measures. During stance in the 11 km trials, tensor fascia latae electromyographic activity was greater running on sand compared with the firm surface (13).

Borreani et al. investigated the effect of 3 different exercises (two leg stance, one leg stance, one leg stance with elastic tubing) performed on 4 different surfaces (sitting on exercise ball, stable surface, soft stability, and rocker board) on the activation of the muscles around the ankle. University students (24 men and 20 women) attended this study, voluntarily. During the exercises, fibularis longus, tibialis anterior, and soleus muscle activation was evaluated with superficial EMG. The greatest sEMG activity for all muscles appeared one leg stance on a soft stability surface with resistance tube. The least EMG activity for the tibialis anterior and soleus muscle was in a seated position and for the peroneus longus in an erect two leg stance position without resistance tubing (14).

Alfuth et al. investigated the effect of balancing on one leg on textured and smooth balance devices on the activation of lower extremity muscles. Twenty-six young healthy volunteers (12 females, 14 males) were included in the study. Participants were asked to balance on one leg on two different balance boards. Examined muscles were tibialis anterior, fibularis longus, soleus, gastrocnemius medialis, rectus femoris, vastus medialis, biceps femoris, and gluteus medius. Muscular activation was examined by superficial EMG. Muscle activation was not different when both balance board materials are compared. It could not be recommended to use textured balance materials for altering lower extremity muscle activity during one leg stance in favor of smooth textured balance materials (15).

Rahman et al. investigated the effect of balancing with eyes open on muscular activation on three different balance devices (BOSU ball, balance cushion, and wobble board) and hover boards. In this study, tibialis anterior and gastrocnemius muscle activation was evaluated with s-EMG. Seventeen healthy adults were required to stand on three balance training device and a hover board for two minutes. It was observed there is not much difference between balance devices and hover board in terms of muscle activity of both tibialis anterior and gastrocnemius muscle (16).

3. CONCLUSION

The use of materials or devices with different stability properties during exercise or physical activity significantly affects muscle activation. This effect occurs in different ways in different muscles. As the stability of the material or rehabilitation materials with different stability properties decreases, it significantly increases muscle activation in some muscles of the lower extremity. Changing the hardness and type of the rehabilitation material used does not cause a change in the activation of some muscles. For this reason, it is important to choose the rehabilitation material suitable for the purpose. For this reason, it should be decided well in which muscle activation change should be made in physiotherapy and rehabilitation program. Then, suitable rehabilitation materials with different stability properties should be selected for this purpose.

Conflict of interest statement

There is no conflict of interest between the authors

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