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Applications of Training with Instability Devices to Health and Sport Performance

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Abstract

The aim of this work was to analyze the relevant characteristics of instability devices that will allow an effective selection of their training applicability to health and sport performance.

Based on practical training experiences with different instability devices and the support of research literature, it was carried out the comparison among three different unstable apparatus (the T-BOW®, the Bosu and the Freeman Plate), by using the following criteria: 1) the level of static-dynamic reactivity, 2) the conditions of each support on the device, 3) the axes causing movement instability and range of imbalance.

While training with Bosu can be applicable to softer surfaces, training with T-BOW® and Freeman plate can be more applicable to harder surfaces like many of the daily life and sports. The support on flat surfaces, as on the Bosu and Freeman Plate in their unstable positions, requires unilateral control of the foot and is applicable to activities practiced on flat surfaces. The support on the narrow edges of the T-BOW® (unstable position) requires bilateral control of the foot and is applicable to activities practiced on different-design surfaces. In their stable positions the three devices have rounded surfaces offering multiple support options, always conditioned by the level of reactivity of each device.

Extraordinarily selected coordination training on a certain unstable device can provide some general coordination support to optimize certain specific balance training; however, the use of unstable devices can be more appropriated, when well selected, for general-special conditioning training.

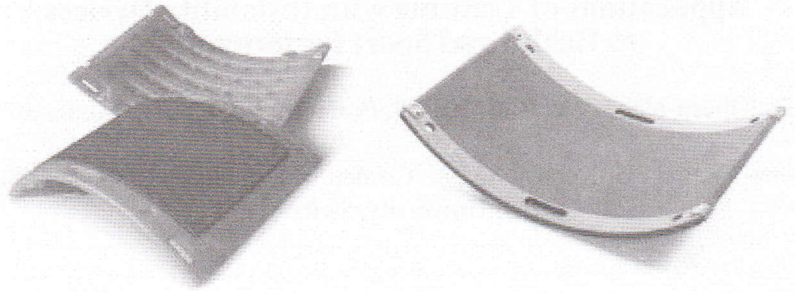
Mastering the movement education and training resources is the most relevant factor in order to optimize unlimited situations of static and dynamic balance in specific movement abilities that are developed in daily life and sports.

Key Words: *Instability Device, Training, Health, Sport, T-BOW®, Bosu, Freeman Plate*

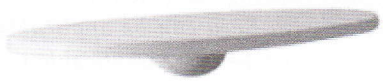
Introduction

In most of the daily life and sport, individuals must perform tasks under unstable conditions, but not very often on instability devices.

The analysis of research and literature about training with instability devices shows lacks of detailed criteria of the factors affecting the imbalances created by a specific device and usually consider the terms instability and imbalance as general concepts. Thus, there is a need to define consistent and concrete criteria for using instability devices that will allow an effective selection of their training applicability to health and sport performance.



T-BOW® (plastic and wood versions)



BOSU **FREEMAN PLATE**

Methods

Based on practical training experiences with different instability devices and the support of selective research literature, it was carried out the comparison among three different instability devices (the T-BOW®, the Bosu and the Freeman Plate), by using the following criteria: 1) the level of static-dynamic reactivity (softness and elasticity of the device, in relation to its weight), 2) the body parts supported on the device (one foot, the feet simultaneously, one foot plus one hand, etc.) and the conditions of each support (how feet, hands or any body part can be placed on the device), and 3) the axes causing movement instability (from 1 to several axes) and the range of imbalance.

Results

Currently, the use of instable devices has been incorporated into traditional exercises to potentiate coordination and reduce the rate of injury, but there is much disagreement on the effects of this combination for sport performance and for core stability activation (Behm, 2010; Willardson, 2007). Reports by Cressey (2007) have revealed that training on an unstable surface offers no increase in the EMG for core training and no increased performance in athletes.

Resistance training while using an instability-training device is known to increase activation of stabilizing muscle groups while decreasing the force generated by the prime movers. Willardson (2007) comments that despite the popularity of core stability training, relatively little scientific research has been conducted to demonstrate the benefits for healthy athletes, and states that while core stability is required for successful execution of sports skills, very few sports skills require the degree of instability inherent with Swiss ball exercises. Chulvi-Medrano (2010), carried out an study comparing the strength and paraspinal muscle activity between deadlifts performed in a standard way (stable ground) and with different instability devices (Bosu and T-BOW®).The subjects produced more force and muscle activity on the stable surface than under the other conditions during the isometric test, and the same differences in muscle activity were observed during the dynamic test. On the other hand, in the T-BOW® device trial the maximum dynamic and isometric contractions and the maximum isometric force were larger than in the Bosu condition.

Balance can be seen as a skill that will gradually deteriorate with age, causing greater risk of falls and fall-related injuries, which in turn affects healthy life expectancy. A lower-limb training program in healthy elderly women using the T-BOW® device showed significant improvements in static balance, dynamic balance and overall balance (Chulvi-Medrano, 2009).

During the training with the unstable platform the instability of movements provide unstable conditions to the joints, hence, activating proprioceptive impulses which are integrated in several sensorial-motors centers and regulate the automatic contraction of postural muscles maintaining general postural balance (Mattacola and Dwyer, 2002).

Several studies have demonstrated that spinal stretch reflexes responses are modified by training practices and may be a required adaptation if athletes are to reach high levels of skill development (Koceja, 1995); showing the outstanding level of adaptability of the peripheral nervous system and its relevant interaction with the central nervous system, even in the smallest imbalance situations.

The term proprioception (kinesthetic sense or kinesthetic plus vestibular senses, depending on authors) associated with the peripheral nervous system reactions is often used for training with unstable devices; however, implemented under such conditions does little to injury prevention, avoidance of falls or balance control, being therefore necessary to incorporate training situations that strongly demand the interaction of the central and peripheral nervous systems (Seirul-lo Vargas, 1987).

The optimal approach to improve balance for healthy athletes might be through practice of relevant skills and movements on the same surface on which those same skills and movements are performed during competition (Willardson, 2007).

a) Criterion of Reactivity.

The characteristic softness of the half sphere of Bosu delimitates its degree of reactivity extraordinarily, despites its rounded shape also influences. Thus, it may be applicable to certain surfaces of rubber, mats, soil and snow with similar softness, with a range of variability since it can be inflated. We dismiss the Bosu as an effective tool for improving specific balance in hard surfaces where many sports are practiced and where many actions of the daily life in towns are developed. The soft component of Bosu causes slow changes of inertia when tiny movements are performed on it, both when placed on the base or on the dome, and, therefore, its level of reactivity is low and very different from the level experienced in the mentioned situations.

On the other hand, the T-BOW ® (in its plastic and wood versions) and the Freeman Plate (especially, in its original wood version) in their unstable positions, thanks to its light weight, rounded-sphere contact surfaces and very elastic components, have a remarkable reactivity and changes very quickly its inertia with any tiny movement performed on it. Under this consideration, the T-BOW ® and Freeman Plate are very effective tools for improving specific balance in hard surfaces where many indoor and outdoor sports are practiced and where many actions of the daily life in towns are developed. In their stable positions, while the Freeman Plate offers a very hard and non-elastic sphere surface, the curved surface of the T-BOW ® is also hard but it maintains certain degree of elasticity that can cushion a little the impact on joins.

Having the possibility to place under each device materials with different levels of softness simulating levels of reactivity; we conclude that the BOSU have margins of applicability delimited from soft and little reactive surfaces to very soft and very little reactive surfaces, while the T-BOW ® and Freeman Plate have much greater applicability margins, delimited from highly reactive surfaces to very soft and very little reactive surfaces.

Note also that the reactivity characteristics affect the whole body rebalance reactions and not only the support part in contact with the device.

b) Criterion of Support Conditions.

The level of applicability of each unstable apparatus in relation to the conditions of support is totally limited by its reactivity.

Imbalances with support of feet on flat surfaces, such as in the unstable positions of Bosu and Freeman Plate, require bending the outer ankle and so a unilateral control by the muscles located at one side of the foot, only until a range of imbalance in which the foot slips. Therefore, they may have applicability to activities and sports practiced on flat surfaces.

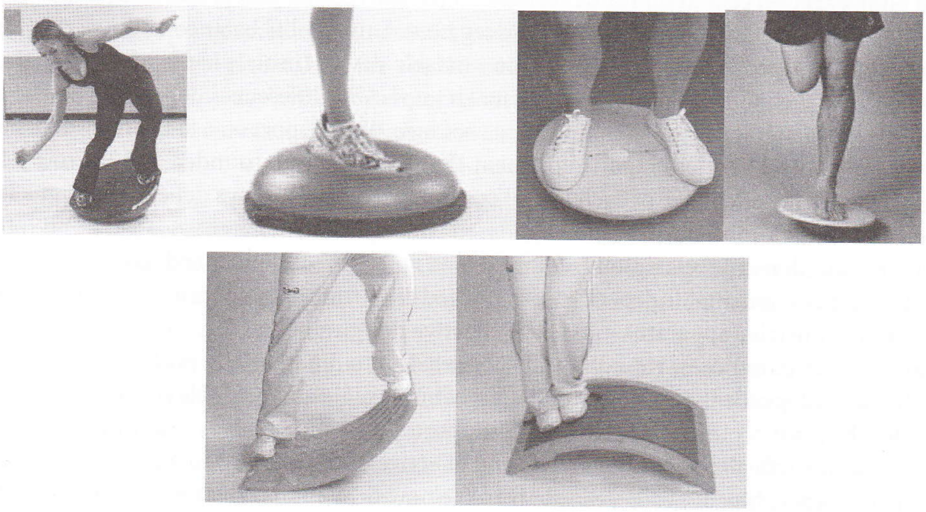
Imbalances with support of feet on the narrow edges of the T-BOW ®, in its unstable position, require a tiny bent of both sides of the ankle and so a bilateral control by the muscles located at both sides of the foot optimizing segmental independence of the leg, by special stimulation of intra- and inter-segmental dynamic relaxation, specially every time that the edge contacts the ground, since the verticality of the support leg can be maintained during the all range of imbalance. The unstable position of T-BOW ® also offers a concave-curved surface, allowing foot supports on both sides bent and flat.

Consequently, these situations may have applicability to activities and sports practiced on uneven and varied-design surfaces.

Other static and dynamic supports of trunk, hip, knees, head and arms can be performed on the unstable positions of Bosu, Freeman Plate and T-BOW ®; as well as some combinations of these supports with foot and hand supports. However, their different levels of comfort and reactivity should be considered.

The stable position of the Freeman Plate provides a tiny half-sphere for some highly reactive supports of hands and small parts of the foot. The Bosu stable position (dome site up), although it is unstable due to its deformation when we step on it, provides a big half-sphere for multiple little reactive supports of different body parts. The stable position of the T-BOW ®, with some degree of elasticity when we step on it, provides a big curved-convex surface for multiple highly reactive supports of different body parts.

The foot step on the Bosu, Freeman Plate and T-BOW ® can be done with sport shoes and barefoot, while the wood version of the T-BOW ® is also effective wearing socks.



c) Criteria of Instability Axes and Range of Imbalance.

Several axes are causing movement instability in the Bosu and Freeman Plate (unstable positions), because their half sphere side provokes multidirectional paths. This situations can be too difficult for many people and a new challenge for elite athletes, although there are only some sport techniques of a few sports in which the surface where are performed provokes multidirectional imbalances. In the basic unstable position of the T-BOW ® there is one axis causing movement instability. This is beneficial in order to create very basic levels of imbalance that are already a challenge for many people. You can also spin (rotation in the vertical axis) and thus having two axis of imbalance during this action. If necessary you can use the double T-BOW ® (convex sides in contact) to have two constant axes of imbalance.

The range of imbalance in the Freeman Plate (unstable position) is very small since the round flat surface will hit the ground, unless it is placed on another tool. In the Bosu (unstable position) the range of imbalance is big. However, in both cases the efficient range of imbalance is small since the support part (e.g. foot) will slide after certain degrees of extension. In the T-BOW ® the range of imbalance is also big and, differently, its efficient range is also big since the support on the narrow edges allows maintaining the verticality of the leg and foot without slipping during the complete range.

The stable position of the Bosu (dome site up) also provokes multidirectional displacements when stepping on it, but with tiny ranges of imbalances due to its shape and low reactivity.

Discussion

Factors to consider in differences between balance devices are as follows:

The level of static-dynamic reactivity (function of the elasticity-softness and weight of the device and person which also influence the inertia of the system) is a very relevant factor to determine the applicability of any unstable device, since minor changes in reactivity can greatly change the timing and specificity of tactile and kinesthetic sensations, affecting the interaction of all interoceptive and exteroceptive sensations for control and regulation of movement. Then, it is only useful and effective to train on surfaces which reactivity is very similar to the real surface where a sport practice or movement activity is developed.

The body parts supported on the device determine the contact points and forces exerted on the device that will produce reactions on the segmental and global balance of the person. For instance, when a specific foot is placed on an unstable device (initials levels of segmental independence), the conditions of support can make important differences depending on the required level of bilateral control to maintain the balance. The support on a flat surface demands less bilateral control and less rapid adjustment than on a curved, rounded and narrow-edge surface, where a faster change of each lateral control is required, always dependent on the level of reactivity. As a consequence, such increased bilateral control potentiates intra and intermuscular static-dynamic relaxation (advanced levels of segmental independence).

Evidently, the segmental independence can also be optimized in sport and specific surfaces; hence, any unstable apparatus must have effective design surfaces (e.g., narrow edges, concave and convex curvatures, rounded and sphere sides) to differentially potentiate all factors of segmental independence by close simulation of both stable and unstable specific situations.

Besides the most typical balance with the support of feet and hands, a multifunctional unstable apparatus will also should offer safe and effective options to support other parts of the body, such as knee, hip, upper-lower-side trunk, elbow-arm and head; as well as their combinations with feet and hands.

A relevant issue to be considered is the big change of the dynamic sensations of the support parts during the sliding of sports such surfing, windsurfing, skiing, snowboarding, roller and ice hockey, etc., and in some sliding actions of some sports and daily activities. Thus, it should be pointed out that instable devices cannot simulate such sliding movements and only very tiny approaches can be achieved with some apparatus and selected situations.

The axis causing movement instability (from 1 to several axes) will determine the path of the center of gravity of the balancing person, one way or multidirectional, and thus it will mainly affect the changes in the global balance positions. It should be pointed out that even with an unique axis of imbalance the possibilities to optimize the static-dynamic balance are extraordinary, since the body can be oriented and positioned in different ways on the device.

The range of imbalance will define the displacement length of the center of gravity on a certain direction, will limit in most cases the extension to which the support part/s of the body can slip out the device and, as a consequence, will also limit the range and time that the alignment of a segment (mostly legs and arms) can maintain its functional axis.

It is evident and extraordinarily important to point out that the surfaces of many daily activities and where many sports are practiced do not move or sway or tilt. These surface-tilt situations occur in water sports, with constant variations, and in some outdoor sports or activities when we step on a mobile land, or on a mobile stick, rock or piece of any tool. In most situations is the person alone, or with specific clothing or material (e.g., skis), who must adapt his movements to stable, uneven and varied surfaces.

In addition, we only find a few sport and daily life situations in which the imbalances are multidirectional (through several axis), since in most cases there is 1 or 2 axis causing the movement imbalances.

Another factor should be added to the initial criteria selected for the analysis of balance devices: the surface's characteristics (more or less slippery, and type of design) interaction with the clothing of the body part/s in contact with the device (barefoot, with socks, with sports shoes, with boots, with gloves, etc.), since it directly affect the kinesthetic and tactile sensitivity (haptic sensation) for an efficient peripheral control and regulation during rebalancing.

On the other hand, some unstable devices can have interesting utilities for general conditioning, strengthening small muscle groups, stability of the joints, having a stable and strong back, postural improvement, and for comfortable stretching-relaxation postures. Evidently, the combination of such devices between them and with other mobile and fixed tools is a source of endless resources that the expert should appropriately select.

Conclusions

Well chosen coordination training on a certain unstable device can provide some general coordination support to optimize certain specific balance training; however, the use of unstable devices can be more appropriated, when well selected, for general/non-specific conditioning practice.

Accordingly, before designing any additional training with unstable devices one should very carefully analyze the interaction of the following criteria: 1) the level of static-dynamic reactivity, 2) the body parts supported on the device and the conditions of each support, 3) the axis causing movement instability and the range of imbalance, and 4) the interaction of the surface's characteristics with the clothing of the body part/s contacting the device.

By creating non-specific and artificial environments with unstable apparatus in an effort to sell a product shows little education and a lot of irresponsibility.

Mastering the movement education and training resources is the most relevant factor in order to optimize unlimited situations of static and dynamic balance in specific movement abilities that are developed in daily life and sports.

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