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Functional Balance Training Using a Domed Device

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summary

Balance is an important aspect of athletic and occupational performance, in the elderly, and for injury rehabilitation, where use of a novel domed device can be incorporated to any well rounded program. The use of dynamic, non-dynamic, and core stabilization exercise enhance balance. This article offers exercises to improve balance that are applicable for any exercise professional.

The BOSU Balance Trainer (DW Fitness, LLC, NJ) (3), or "both sides up" dome, is an exercise device used to enhance balance, torso or core strength, and proprioception in an over-40 population attending a senior service college for military leaders. The flat portion of the device is a 25-inch platform with 2 recessed handles, and the flip side is an inflatable rubber dome rising approximately 1 foot above the floor. Each side can be used in different ways to create the functional athletic training experiences described in this article. Many other balance training devices currently on the market (e.g., balance boards, disk pillows, balance pads, foam rollers) are used for athletics, fitness, and rehabilitation. This novel device will add yet another tool for the exercise professional to use for training and improving balance across a wide range of populations.

Maintaining balance is a fundamental component of performing nearly every physical movement. Balance is an innate ability, yet it is also a learned skill. Balance involves the coordination of muscles, which requires practice and refinement throughout one's lifespan. Balance has both anatomic and sensory components that enable the body to stabilize in a specific position (15). Proprioception, a word often used synonymously with kinesthesis, refers to the awareness of body movement and orientation to the positioning of the body in space. Body symmetry is accomplished through the coordination of a synergism of responses supplying the brain with continuous information. Somatic sensory receptors (i.e., muscle spindle fibers, Golgi tendon organs, and cutaneous receptors), vision, and the vestibular system of the inner ear all serve in this synergistic response to maintain balance (2, 6, 13). Visual cues, somatic sensory awareness (proprioception) of joints, and vestibular input are processed in the cerebral cortex to continuously synthesize a person's orientation in space (5). Vestibular and vision receptors are stressed during balance training, thus enhancing proprioception in limbs and body and thereby increasing balance. Training these systems to work efficiently may reduce the likelihood of injuring the ankle, knee, and lower back.

Balance deteriorates as a natural process of aging. Muscle strength, range of motion, and vestibular sensitivity also diminish with advancing age. Additionally, physiologic changes caused by illness or inactivity at any age can contribute to premature loss of balance and proprioception (11, 16, 17). Research involving balance training in athletes is lacking, and the literature to date concentrates on the elderly and the injured (7, 10, 18).

Functional balance training involves skilled body movement patterns that simultaneously require movement and stabilization force production. That is, one part of the body is in motion while another is held immobile (15). Most

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physical or sporting activities also require balance and the control of body movements while carrying additional weight, such as a skier's equipment or a soldier's 80-pound rucksack, or circumventing obstacles, such as a football player. Additionally, the athlete who performs on an unstable or "slippery" surface (e.g., skiers, trail runners) must train on equally unstable surfaces to improve performance and reduce the risk of injury. A study performed in nonathlete, physically active subjects demonstrated that balance exercises are necessary to improve balance, independent of strength training (8). Clearly, these examples can be applied to many occupations, not only in the athletic realm, but also in occupations with demanding physical requirements, such as the military, fire fighting, and law enforcement.

Core strength is an important aspect of an athlete's training and performance that is often neglected. As the term "core" implies, it is the central portion of the body, or torso, where stabilization of the abdominal, paraspinal, and gluteal muscles are critical for optimal performance (12). Core strength training is used synonymously with lumbar or spinal stabilization and motor control training (1). Electromyography recordings of the rectus abdominis and erector spinae muscle are used to measure core muscle activity (4). Research has demonstrated that performing core exercises on an unstable surface isolates core musculature much more effectively than a traditional abdominal device (19). Core training is used in the realm of athletics and rehabilitation, with much of the literature concentrating on rehabilitation of the lower back (9, 12). Balance training, like other forms of training (strength training) or activities (throwing), requires the core to be stressed and overloaded, therefore increasing trunk strength. The relationship between a strong core and functional balance has been established in the elderly, but literature in regards to athletes is not available and warrants further study (14). It is logical to deduce that an athlete, soldier, or recreational exerciser will increase balance by increasing core strength. The exercises described in this article train the core isometrically or dynamically.

Table 1
Balance Exercises

Exercises	Ability dependent guidelines	Repetitions
Double leg balance (DLB)	Starting position 0:10–1:00	Repeat until comfort level is achieved.
DLB-eyes closed	0:05–0:30	3–5
DLB- head side-to-side	Slow controlled movement	3–5 from left to right
Single leg balance (SLB)	Slow controlled movement	3–5 each leg
SLB-leg abducted	Hold for 5–10 seconds	3–5 each leg
Push-ups	Knees→ Feet: 2–3 sets	Fatigue
Front-leaning rest	0:10–1:00	3–5

Note: The Double Leg Balance (DLB) is the starting position for all other exercises. Proficiency will increase as additional exercises are performed in the DLB position.

Balance training mimics other forms of physical training, beginning with the fundamentals, which are progressively modified (duration, repetitions, and level of difficulty) over time. The exercises described in the following sections begin with a basic starting position from which other exercises will originate. Once a comfort level is achieved, additional, more dynamic maneuvers are performed as described. Stepping off the dome for less than 1 minute between exercises is recommended to allow feet, ankles, and core to rest. These exercises should be performed 3 times a week on nonconsecutive days.

Balance

Ability dependent guidelines and suggested repetitions for balance exercises are presented in Table 1.

Double Leg Balance (DLB)

The double leg balance (Figure 1) is performed on top (dome side up) of the device in a "centered position." Place feet about hip-width apart or narrower, with knees flexed or "soft." Keep shoulders and hips parallel to the floor and with hands placed on the hips. A neutral spine

Figure 1. Double leg balance.

Figure 2. Double leg balance/head side-to-side.

Figure 3. Single leg balance.

position should be maintained throughout the exercise. Little to no movement is desired as the body adapts to a centered position. Proprioception is further challenged and significantly improved when the eyes are closed while maintaining the centered position. Adding movement challenges the core, thereby increasing core strength, as well as strength to the ankles and feet. A simple rotation of the head from side to side, looking to the right then to the left with eyes open, improves the ability to maintain a stable centered position (Figure 2). For added difficulty, the eyes can be closed while the head is moving from side-to-side.

Figure 4. Platform push-up.

Figure 5. Front-leaning rest.

Single Leg Balance

To enhance both stability and balance, a progression of exercise should include single leg balance (SLB), thereby providing an increased stimulus to proprioceptive mechanisms. Step on the center of the dome with the right foot, arms out to the side for balance. With the foot of the left leg touching the outside of the dome, attempt to maintain a stable position without additional movement. To increase difficulty, slowly abduct the left leg away from the device while keeping a neutral spine. The pelvis and shoulders should remain parallel with the floor. Perform the single leg balance (Figure 3) on each leg. To further increase difficulty, abduct the leg up higher or slowly bring it forward of the body, moving the arms to counterbalance the abducted leg.

Platform Push-up & Front-Leaning Rest

The platform portion of the device (dome side down) can also be utilized. To increase balance, stabilization, and strength in the shoulders, arms, core, and hips, begin by placing the hands on the platform recesses with the knees on the floor. Raise the body to a prone position from the shoulders to the feet, resting the chest on the platform. While maintaining this position, extend and flex the arms repeatedly to fatigue (Figure 4). To increase difficulty, perform the push-up with eyes closed to elicit a greater demand on the vestibular system. To isolate the core and shoulders, hold the body in a straight alignment while the elbows are fully extended, performing the front-leaning rest position. To increase difficulty, lift a leg up off the ground, alternating legs (Figure 5).

Table 2
Dynamic Balance Exercises

Exercises	Ability dependent guidelines	Repetitions
Squat	Lower depth of squat to ankles.	2 × 10
Squat twist	Lower depth of squat to ankles.	2 × 10; right/left = 1 reptetition
Visual tracking	Slow deliberate movement	3–5 left/right = 1 repetition
Walking/marching	0:30–1:00	3–5
Bounce	0:30–1:00	3–5
Jump	Increase height of jump as ability increases.	2 × 5–10

Dynamic Balance

Ability dependent guidelines and suggested repetitions for dynamic (DB) exercises are presented in Table 2.

Squat and Squat Twist

Begin in the DLB position and slowly lower to a squat position (as low as is comfortable while maintaining stability). As the body lowers, raise the arms in front of the body to counterbalance the movement (Figure 6). For variation, return to the DLB position and slowly perform a squat twist (Figure 7) to one side of the body, touching the knees, shins, or ankles. The ability to remain stable, balanced, and in proper alignment determines the depth of the squat position while adding a twist. Proceed to the opposite side of the body in the DB squat twist.

Figure 6. Squat.

Figure 7. Squat twist.

Visual Tracking

Performing head and arm movements (visual tracking) while maintaining a DLB position creates additional challenges to the visual sensory system. With arms at both sides, raise an arm to the side until it is parallel to the floor. Simultaneously raise the opposite arm from the side of the body forward while visually tracking the hand towards the ceiling. Follow the hand back to the side of the body to the DLB position (Figure 8). Perform the same maneuver using the opposite arm.

Figure 8. Visual tracking.

Figure 9. Walking/Marching.

Walking/Marching

Walking and marching are a common part of normal daily activity. Balance and stability directly affect our ability to perform these activities with control. While in the DLB position, flex the right leg, bringing the heel slightly off the dome. As the right leg pushes off, flex the opposite leg in a marching or walking motion. Begin by keeping the arms to the side, and then swing the arms to simulate walking (Figure 9). Increase heart rate response by vigorously swinging arms and lifting the knee of the extended leg as high as possible.

Bounce & Jump

Bouncing incorporates a high degree of challenge to balance as the body leaves the surface area of the dome and then returns. Begin by bouncing slightly with both feet remaining in contact with the surface area of the dome portion. Arms may be extended to counter-balance the movement, or the hands may be placed on the hips. From a bouncing move-

Figure 10a–b. Jump Stick.

ment, flex the lower body and extend upward using the arms to achieve clearance from the surface of the dome. Jump as high as possible while maintaining proper alignment and control. The landing or return requires soft knees and is not to be done straight legged. A "Jump-Stick" landing insures little movement in the body in order to resume balance (Figure 10a and b).

Application

The creative application of balance and dynamic balance exercises using this balance training device ranges across all aspects of physical training. In addition to the myriad athletic training applications, most of the exercises described can be particularly beneficial to individuals requiring improvement of joint stability or core strengthening after illness or prolonged inactivity. While some people with mild to moderate joint instability are encouraged to use these exercises to improve functional capacity, there are several notable recommended exceptions. Some of the limiting parameters would exclude anyone with the following conditions: very unstable knees or ankles, recent orthopedic surgery, herniated vertebral disk, or any form of severe degenerative joint disease.

Clearly, this unique and functionally applicable device can be implemented in many aerobic and strength training exercise sessions or classes. The BOSU Balance Trainer is a beneficial tool for athletic trainers, strength and conditioning coaches, physical therapists, personal trainers, and group fitness instructors. The balance training described in this article is only one of many applications. This balance training device offers a diverse way to integrate functional balance, core, and strength training routines into nearly all athletic and fitness programs. ♦

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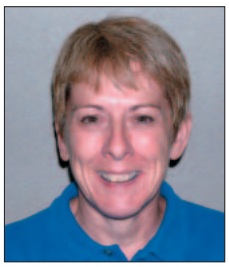

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