Balance Training in a Volleyball Strength and Conditioning Program

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Strength and conditioning professionals often focus exclusively on increases in strength, power and speed when designing training programs. While each of these components is vital to optimal athletic performance, balance training should also be included in the conditioning program of volleyball athletes.

Why is balance important in volleyball? A lack of balance will inhibit performance and increase the risk of injury or re-injury to athletes. Think of moving quickly to dig a well-struck ball off the floor or adjusting your body position in the air as you go up for a kill. Both are examples of game situations when superior balance capabilities would improve an athlete’s performance.

Furthermore, in essence, running and turning are a series of stepping strategies. During running, the body is displaced forward beyond its base of support. Balance is regained as the leg is brought forward to catch the body and prevent a fall. During running and cutting activities, balance is successively lost and regained. These demands become even greater when a volleyball athlete is performing these movements while simultaneously handling the ball.

Just a few years ago, performing balance training in the gym would have attracted a lot of odd stares. However, the importance of balance training is now more readily accepted in the training programs of athletes.

Definition of Balance

Balance has been defined as a type of movement control, where the body's state of equilibrium is controlled for a given purpose. Balance has also been defined as a state of body equilibrium, or an ability to maintain the center of body mass over the base of support without falling. A broader definition suggests balance can be described in three ways — the ability to maintain a position, the ability to voluntarily move, and the ability to react to forces acting to disrupt balance.

Bodily Systems Involved in Maintaining Balance

The ability to balance is a result of systems working together. Through the complex, automatic integration of several body systems, we are able to accurately sense where our bodies are positioned in space in relationship to the earth and adjust the tension in the precise muscles as needed to maintain safety and alignment. In athletes, these units must function optimally or sport performance will be adversely affected.

Balance in sport requires a complex integration of external and internal input. The ability to balance involves three systems — the somatosensory system, visual system and vestibular system. If any of these systems is damaged or compromised, the central nervous system receives inaccurate information that affects balance and coordination. Further, because the three systems send the central nervous system information about the body's position in space from three different perspectives, the body has the ability to internally compare the various sets of information and filter any inaccurate data.

Somatosensory System

This system provides information about the support surface and orientation of body parts to one another in space. The information comes from pressure and vibration receptors in the skin and from proprioceptors in the muscles, joints and ligaments. The proprioceptors give input on angles and accelerations. The somatosensory system is the primary system used when the support surface is smooth and stable (e.g., a floor or street). Somatosensation (proprioception) is important for adequate postural control. Proprioception is the ability to receive input from muscles, tendons, and joints and to process that information in a meaningful way in the central nervous system. Information received from joint receptors assists athletes in knowing where their limbs are in space.
If your leg has ever gone to sleep, you know the importance of pressure receptor information. It is very difficult to stand or walk without the automatic muscle activation that occurs in response to input from pressure receptors in the skin of your legs and feet.

Visual System

The visual system provides input to assist in balance control. This system is responsible for providing information about the relationship of the head and eyes to surrounding objects. It is the primary system used when the support surface is irregular or unstable (e.g., rough ground, soft foam, a moving surface). The visual system can give the central nervous system conflicting or inaccurate information when it is dark or when surrounding objects are moving. The visual system provides input to assist in balance control through vestibulo-ocular input. An athlete receives information about his or her position in space and is able to keep a visual image centered on the fovea (area of keenest vision within the eye). Eye movement counteracts the effect of head movement, with the eyes moving in a direction opposite of head movement.

The Vestibular System

The vestibular system is an important aspect of balance control. Information supplied by the vestibular apparatus assists in maintaining the body upright against the force of gravity and in determining linear and angular acceleration. Located in the inner ear, this system gives information about head movements relative to gravity, irrespective of external objects or support surface. One part of the system tells whether the head is right side up, upside down, tilted (which way and how much) or sideways. The other part involves the semicircular canals of the inner ear. These fluidfilled semicircles are oriented in each of the three planes of motion — sagittal, frontal and transverse. In the sagittal plane, in which flexion and extension occur, the body is split into right and left halves. In the frontal plane, in which abduction and adduction occur, the body is split into front and back halves. In the transverse plane, in which internal and external rotation occur, the body is split into top and bottom halves. As the fluid moves during head motion, information about the direction and speed of the head's movement is transmitted along the vestibular nerve.

When the somatosensory and visual systems are available and working, the vestibular system seems to be more concerned with head and eye control. Precise control of head movement and eye position is very important in complex activities such as catching a ball while moving, kicking a ball or even running. In the absence of disease, the vestibular system is seldom inaccurate, so the brain uses it to perform checks and balances, identifying and ignoring inaccurate input from the other two systems.

Balance Innate But Can be Improved

To a great extent, balance is innate. However, as coaches know, with training and experience balance can improve enormously. Using carefully designed balance programs the coach can help athletes improve their balance. Balance training can also help athletes develop their motor skills, increase body awareness and improve visual awareness. Two of the most basic ways to improve balance are improvements in flexibility and strength levels.

Flexibility

Balance problems can be related to flexibility. If an athlete is concerned about losing his or her balance, general muscle tension increases and a specific predictable posture to compensate for balance problems is used. One compensation strategy is to stand and walk with the feet farther apart to widen the support base. Alternatively, an athlete might stand and walk with the knees, hips and/or back slightly flexed to lower the center of gravity to a more stable position. These new postures, which will become habitual, combined with increased muscular tension due to fear and anxiety about falling, will effectively decrease the flexibility of the joints involved.

Decreased shoulder flexibility can also affect the dynamic balance involved in activities such as reaching for objects. In these activities, upper body movements change the center of gravity. If larger body parts, such as the torso or legs, must compensate for limited shoulder motion, the center of gravity shifts more, making balance a greater challenge.

Incorporating flexibility training to increase range of motion and proprioceptive input, particularly at the shoulder, torso, hip and ankle, will help reduce these problems.

Strength

Strength is another factor that is important for balance during sports. An athlete who lacks adequate strength to perform a skill may be unsuccessful and injury may occur. Lower-leg strength is especially important for maintaining dynamic balance. It has been determined that ankle dorsiflexor strength is much weaker in persons who fall frequently than in those who don't. Poor dorsiflexor strength, especially when combined with poor pelvic mobility, decreased hip flexor strength and poor depth perception can contribute to an increased incidence of tripping. Athletes with weak lower legs also show a greater tendency to use their large hip muscles to recover balance. To maintain balance, these individuals tend to bend at the hip or waist. If their hip extensors are also weak, the bend occurs at the waist, which in turn leads to stress and pain in the lower back. A lack of strength in the calf muscles can cause decreased speed and a shorter stride length. Also, decreased strength in the hamstrings, gastrocnemius muscles and quadriceps is associated with an increased incidence of falling.

Developing strength is important because strength is critical when attempting to regain balance. Strengthening the back extensors, abdominals, hip flexors, hip extensors and lower leg muscles (plantar flexors and dorsiflexors) are all important in maintaining balance. The quadriceps, adductors and abductors are also very important in maintaining balance.
Balance Training

As with other types of training, balance training must be specific to the type of balance required by the sport, whether that be static or dynamic balance. For example, a gymnast needs to perform static balance maneuvers on a variety of different surfaces including a beam, foam mats and spring floor. Balance drills may be initiated by practicing unilateral standing on a floor. As improvement occurs, the degree of difficulty can be increased by progressing to balance activities on a foam mat, spring floor or both. To prepare a gymnast for competition on the beam, balance activities on the beam must be included.

For best results these balance activities should be practiced on a beam that is of similar width and length to the beam used in competition. For safety reasons, initially the beam should be placed in a low position. However, as confidence and skill improve, height of the beam should gradually be raised to the normal height to provide appropriate visual cues. Eventually, gymnasts should practice balance activities in the environment in which they will compete. This will allow them to develop visual and auditory cues that will assist them in maintaining their balance. Alterations from their normal settings may disturb their balance.

Gymnastics requires a combination of static and dynamic movements. For example, a walkover on the beam must be followed by static balance with the feet in a tandem position, or a dismount from the bars must be "stuck" by the gymnast holding the position after landing. These activities require a combination of dynamic and static balance. Training of a gymnast must be planned to address the needs for postural control during dynamic and static activities. This should be accomplished through sport-specific drills.

Dynamic activities should be used to develop balance and control for athletes included in activities such as running, jumping, landing, cutting and pivoting. These activities require athletes to repetitively lose and gain balance while performing the sport without falling or becoming injured. This requires development of strength and endurance of the muscles throughout the lower extremity. Additionally, the athletes must be able to recruit the musculature with the proper timing and sequence to allow smooth, coordinated movement. This requires repetition to develop skill and acquire the appropriate motor pathways. Initial development of these skills requires conscious effort, but over time athletes should be able to perform the skills automatically.

An example of an athlete who requires dynamic postural control is a basketball player. These players must be able to move forward, backward and laterally, and to change direction, cut, pivot and land without losing balance. The athletes must be able to perform these skills with distractions such as keeping an eye on the opponent and handling the ball. Initially, training should be in a controlled environment to allow the athletes to focus on body control. Over time, activities should progress to mimic game situations. Drills to develop and improve dynamic postural control should be developed to meet the demands of the athletes’ sport.

Other Aspects Affecting Balance

In addition to the aspects previously discussed, there are other variables that can affect balance. Some of these variables are discussed below:

1. **Motivation.** Certainly motivation of an athlete can affect whether the athlete will fall or maintain his/her balance during sport performances. In addition, an athlete’s arousal level can either help or hinder sports performance. If an athlete is too aroused, balance may be negatively affected because he or she is not performing the skill the same way that it was practiced.

2. **Practice.** Of course practice and expertise are very important components of balance during sports. For example, it has been shown that teenage gymnasts have automatic electromyographic responses different from non-trained children. It is uncertain whether this is due to heredity or training.

3. **Noise.** Although the auditory system is not usually mentioned in discussions about postural control, it is probably a factor that affects balance during athletic performance. Noise of the crowd could make an athlete fall, especially if the skill is normally practiced in a quiet environment.

4. **Playing Surface.** Variances in playing surfaces can affect balance. It is a common practice for football players to practice on the type of field on which they will play their next game because their performance is affected by the different surfaces. Different surfaces may affect the ability to run, cut, push off or jump.

5. **Focus.** As with other aspects of performance, ability of an athlete to focus attention, especially when performing a difficult task, can affect his or her ability to balance. Children have great difficulty with their balance when they are distracted. Distraction is often used during basketball games so an athlete will miss the basket.

Technique/Quality Must Be Emphasized

As strength and conditioning coaches we generally focus on quantity of movement. How much weight can an athlete lift, how fast can s/he run? While this approach may work with other types of training, focus during balance training must be on the quality of movement. Are the athletes relaxed and under control while performing balance training?

To help athletes develop high quality movement, the strength and conditioning coach needs an analytical eye and ability to teach proper movement. Observe the movements and check for lack of control and loss of balance. Insist on high quality movement in all balance training.

Balance Training at the Air Force Academy

At the Air Force Academy we have placed an emphasis on developing better volleyball athletes through participation in the strength and conditioning program. The goal we set for our athletes is improved athleticism, and training balance plays a significant role in working toward achieving this goal. Among the methods we use to train balance are:

1. **Stabilization.** Once per week our volleyball athletes perform stabilization as a part of their training. The athletes assume a standing
onelegged position with eyes closed. A partner, standing next to each athlete, pushes the athlete from a variety of positions, forcing the athlete to hop and then regain his/her balance. The athletes perform 60 seconds on one leg, then perform a second set of 60 seconds on the opposite leg.

2. Inflatable Disk. We have our volleyball athletes stand on inflatable disks on one leg for 15 to 20 seconds while recovering between sets during their resistance-training program. For example, an athlete may perform a set of pull-downs, perform one set of 15 to 20 seconds standing on the inflatable disk, and then perform a second set of pulldowns when the rest time between sets is complete.

3. One-Leg Exercises. Because of the balance requirements that occur as a result of standing on one leg, our volleyball athletes perform a variety of exercises in a one-leg support position. While standing on one leg causes them to use a lighter resistance than they would be able to use performing the exercise on two legs, we feel we develop a higher level of functional strength having the athletes perform the exercise on one leg.

4. Alternating Foot Exercises. Typically when performing split jerks or split snatches an athlete will always split the same foot forward with each repetition. When the goal of training is to develop maximal strength this makes sense, because it allows athletes to use a greater amount of resistance on the bar. However, when the goal is to develop a volleyball athlete who feels strong and is balanced with either foot forward, it makes sense to alternate the feet in the split position with each repetition.

5. Kegs. By using kegs filled with water and sand we provide our athletes the opportunity to train with a "live" resistance, rather than a static resistance that barbells, dumbbells and machines provide. This significantly increases the balance requirements of the exercise. For example, performing walking lunges while holding a keg on one's back provides a far greater balance challenge than do barbells or dumbbells.

Conclusions

When designing strength and conditioning programs for athletes it is important to remember the goal of training is to improve athletic performance. While increasing strength is important, it is just one piece of the puzzle that contributes to enhancing performance potential. Balance training can easily be integrated into a training program without having a major effect on energy or time requirements. By including balance training as part of the overall training program you are providing your athletes one more way to work toward improved athletic performance.