

PERFORMANCE VOLLEYBALL CONDITIONING

A NEWSLETTER DEDICATED TO IMPROVING VOLLEYBALL PLAYERS

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Core Instability in Volleyball Players

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Lisa was a member of the University of Nebraska volleyball team from 1995-1997. She was introduced to the science of Postural Restoration as a patient under the care of Ron Hruska. She had suffered from long-standing injuries sustained during her collegiate volleyball career and found success with the treatment techniques she learned at the Hruska Clinic and later received from the Postural Restoration Institute. Lisa returned to practice physical therapy at the Hruska Clinic Restorative Physical Therapy Services in Lincoln, Nebraska after completing her Doctorate of Physical Therapy from the University of Nebraska Medical Center in Omaha. Lisa is a member of the American Physical Therapy Association.



Lisa Bartels

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ADV** Core stability is an extremely common term among sports medicine and sports conditioning professionals, and core strengthening is a much emphasized component of many sport specific training programs, including volleyball, because of its obvious integration with dynamic athletic movement as well as its apparent role in injury prevention. For many people, core stability means abdominal strength and or back extensor strength, or they may visualize any number of activities that require an athlete to stabilize one region of the body while they move another. But what is the objective definition of core stability and how is core stability measured, and how is core stability enhanced? The purpose of this discussion is to present a predominant biomechanical strategy that many competitive athletes unknowingly utilize to varying degrees, which can greatly compromise core stability. Instability of the core predisposes athletes not only to back pain, but to knee, hip, and shoulder pathology as well. A general understanding of these biomechanics will provide the reader with the ability to identify those athletes with significant core instability and implement appropriate training strategies that can restore and promote core stability into an already established conditioning program.

The word “core” can be synonymous with the word trunk. The word trunk describes the body of a person, including the sternum and ribs, but excluding the head, neck, and limbs. Muscles of the trunk control posture, stabilize the pelvis, and produce torque about the trunk for movement. Accepted kinesiology texts include five muscular groups as the primary extrinsic stabilizers of the trunk; abdominals, erector spinae, quadratus lumborum, psoas, and muscles that connect the pelvis with the lower extremity—the hip muscles. The last group of muscles mentioned, the hip muscles, which could technically include at least a dozen paired muscles, are probably

thought of least as part of a core strengthening program. It is beyond the scope of this article to discuss the appropriate position and mechanical function of all the muscles that strongly influence core stability, but the top three that are initially required for correct trunk position and function are the left hamstring, left diaphragm, and the left abdominal wall.

Many of the right arm dominant volleyball players that are treated and screened by the Postural Restoration Institute, initially present with a forward torsion of the left hemipelvis which via the sacro-iliac joints is orienting the sacrum and spine to the right and shifting the center of mass (COM) from anterior to the second sacral vertebrae over to the right hip. The reasons for this predominant pattern are many, but mainly have to do with asymmetry in the right and left muscular chains of the thorax, which can easily develop because of right sided dominance and repetitive right extremity use. These muscular chains could be thought of as “core” chains. The bony attachments of the adjacent muscles in a chain are extensively intertwined, thus the position, length tension, and tone in one muscle strongly influences the function of the other.

The postural restoration institute describes two anterior interior polyarticular muscular chains (AICs) in the thoraco abdominal cavity comprised of the psoas and diaphragm, and two posterior exterior muscular chains (PECs) overlying the ribcage and spine comprised of the quadratus lumborum and erector spinae. These four tracts of muscles provide the support and anchor for trunk counter force and trunk rotation to enable upright dynamic activity. During gait the pelvis, spine, ribcage, and extremities should be rotating reciprocally. At the same time the four core chains should also be functioning reciprocally, but if the left AIC over powers the right AIC secondary to right sided dominance and repetitive right extremity use, the left pelvis becomes anteriorly tipped and forwardly rotated thus orienting the sacrum and spine to the right and shifting the athlete’s COM over the right hip. Core stability is compromised and the athlete now must compensate in one or more areas of the trunk and upper extremities to remain balanced over the unlevel pelvis. The greatest impact of the compensatory mechanics is on rib alignment and position because most athletes with a forward left pelvis compensate with upper trunk rotation to the left, which results in the left ribs being externally rotated and the right ribs internally rotated. Many muscles attached to the spine, pelvis and ribs are pulled into suboptimal positions, which alter their length tension relationships and therefore their function. Overtime as athletes con-

tinue to train and compete, neuromuscular adaptation occurs and several muscles become very dyssynchronous. Initially athletes may not experience subjective symptoms, but as neuromuscular adaptation continues and strengthens, the core is further destabilized until various pain patterns begin to emerge.

The clinical side of the PRI utilizes several tests and measures to identify the specific pathomechanics an athlete is using which helps prioritize neuromotor retraining. Some of these tests can easily be utilized by yourselves to proactively screen your athletes. Assessing passive hip internal rotation and trunk rotation, and observing rib position are quick convenient methods that are strong indicators of core stability. Frequently, athletes will initially present with gross asymmetry comparing the left and right sides of hip rotation, trunk rotation, and rib position. In a seated 90-90 position, the hip rotation looks apparently different because the left hemi-pelvis is forward relative to the right. Even though the femurs are aligned straight ahead, the left and right hip sockets are in opposite positions. (Figure 1) Trunk rotation in a supine hooklying position will normally appear limited to the left because the left pelvic torsion oriented the sacrum and trunk to the right. With the lower trunk oriented to the right, rotating the trunk to the left via the femurs will appear significantly limited. (Figure 2) Rib position in the supine hooklying position will frequently appear more superficial or flared on the left because of compensatory upper trunk rotation to the left. When the trunk rotates to the left, the ribs on the left externally rotate and the ribs on the right internally rotate. If an athlete is in a position of left pelvic torsion, their left ribs will statically remain in a position of external rotation. (Figure 3)

The majority of volleyball athletes will demonstrate at least some degree of core instability simply because their sport demands repetitive technical activity on one side of the body. Many athletes that are currently performing quite successfully pain free will demonstrate significant core instability. The best time to address this issue is before pain patterns begin to develop. The ultimate stability goal for your athletes is to demonstrate single leg dynamic ability/strength on the left that is nearly symmetrical with their dominant right side. Before this can occur, the postural or core stability function of the left hamstring, left diaphragm, and left abdominals must be initially restored. The core stability function of the left hamstring is to maintain pull on the pelvis posteriorly in conjunction with the gluts to oppose anterior pelvic rotation by the psoas and back extensors. When the left hemipelvis rotates forward out of alignment for reasons already mentioned, the proximal attachment site of the hamstring tendon is elevated thus placing the left hamstrings on stretch. At this altered length tension position, the ability of the hamstring to oppose the hip flexors is compromised. Once appropriate hamstring position and function is restored the athlete can immediately

progress into upright activity that integrates correct adductor, glut, and quadriceps function (Figure 4). The primary function of the left diaphragm is dependent on the position and function of the left abdominals and vice versa. The primary function of the left diaphragm is to expand the lungs, especially the right apical lung. The left diaphragm fibers possess the greatest mechanical advantage for inhalation function when the left ribs are in internal rotation. This mechanical advantage is lost when the left ribs remain externally rotated. This is a dangerous situation because now the right diaphragm has a greater mechanical advantage and can thus overpower the left diaphragm. The left and right diaphragms distally attach directly onto the lumbar spine. If they are not pulling symmetrically, the stronger side will rotate the spine to that side. In other words the right diaphragm is rotating the spine to the right (Figure 5). The core function of the left abdominal wall is to oppose the descent of the left diaphragm upon inhalation. Think of the diaphragms as muscular pistons that descend in and against a muscular cylinder, the abdominals. The abdominals must provide resistance or opposition against the diaphragm as it descends. If the left diaphragm can not function correctly because the left ribs are in external rotation, the left abdominal wall is not required to work in opposition to the diaphragm (Figure 6). It becomes adaptively weak. Once respiratory function of the left abdominals has been restored they can be utilized correctly for left and right trunk rotation, which is an extremely important part of the volleyball attack and shoulder function in general (Figure 7).

In conclusion, the role of the core in optimizing hip and shoulder alignment is a major concept. Core stability is the foundation and groundwork for optimal hip and shoulder function because of how it affects the position of the pelvis over the femurs as well as the position of the ribcage under the scapulae. The ultimate stability goal a volleyball player can demonstrate is having the ability to stand on the left leg, without upper body support, in a single leg squat position with the lower trunk rotated to the left as they rotate the upper trunk to the right with the left abdominals (Figure 8). This highly dynamic activity can only occur if the left hemipelvis is neutral relative to the right hemipelvis, the COM must be anterior to the sacrum, not over the right hip, and the core muscular chains which include the diaphragms must be able to function reciprocally during gait.

More Information Please!

Please note that techniques provided in Figures 4 through 8 are only examples of the many non-manual Postural Restoration Institute™ techniques that could be considered appropriate for addressing the underlying biomechanical deficit described. For more information and references, please visit www.posturalrestoration.com.



Figure 1



Figure 2



Figure 3

90-90 Hip Lift with Balloon - Figure 5

1. Lie on your back with your feet flat on a wall and your knees and hips bent at a 90-degree angle.
2. Place a 4-6 inch ball between your knees.



Figure 5

3. Place your right arm above your head and a balloon in your left hand.
4. Inhale through your nose and exhale through your mouth performing a pelvic tilt so that your tailbone is raised slightly off the mat. Keep your back flat on the mat. Do not press your feet flat into the wall instead dig down with your heels.
5. Inhale through your nose and slowly blow out into the balloon.
6. Pause three seconds with your tongue on the roof of your mouth to prevent airflow out of the balloon.
7. Without pinching the neck of the balloon and keeping your tongue on the roof of your mouth, take another breath in through your nose.
8. Slowly blow out again as you stabilize the balloon with your hand.
9. Do not strain your neck or cheeks as you blow.
10. After the fourth breath in, pinch the balloon neck and remove it from your mouth. Let the air out of the balloon.
11. Relax and repeat the sequence 4 more times.

PRI Wall Squat with Balloon - Figure 6

1. Stand with your heels 7-10 inches away from the wall.
2. Place a 4-6 inch ball between your knees and a balloon in your left hand.
3. Keeping your back rounded, begin to squat until your bottom touches the wall.



Figure 6

4. Once you are against the wall shift your left hip back. Your left knee will be slightly behind your right and you will feel your left outside hip engage.
5. Squeeze the ball between your knees and inhale through your nose. As you exhale reach forward and across the midline of your body with your right hand.
6. Maintaining the above position, inhale again through your nose this time slowly exhaling into the balloon.
7. Pause 3 seconds with your tongue on the roof of your mouth to prevent airflow out of the balloon.
8. Without pinching the neck of the balloon and keeping your tongue on the roof of your mouth, inhale again through your nose.
9. Slowly blow out again into the balloon as you also reach further across the midline of your body with your right arm.
10. Do not strain your neck or cheeks as you blow.
11. Inhale again through your nose. Slowly exhale into the balloon as you reach further with your right arm.
12. You should feel a stretch across your right chest wall. You will also feel your left abdominal wall and your left outside hip engaging.
13. After your fourth inhalation, pinch the balloon neck, remove it from your mouth and let the air out as you slowly stand up.
14. Relax your legs and repeat sequence 4 more times.

Three Point Stance - Figure 7

1. Lie on your left side with your top leg forward and your bottom back.
2. Prop your trunk up on your bottom hand by straightening your elbow and keeping your hand and trunk in line between your legs.



Figure 7

3. Tighten your lower abdominal wall by arching upward.
4. Place your right hand behind your head and pull both shoulder blades down and together.
5. Keeping your shoulder blades pulled together, slowly raise your hip and waist off the mat. You should feel the muscles in the back of your shoulder blades engage.
6. Hold this position while you take 4-5 deep breaths in through your nose and out through your mouth.
7. Slowly lower yourself back down to the mat and repeat 4 more times.



Figure 4

90-90 Hip Lift with Hemibrige - Figure 4

1. Lie on your back with your feet flat on a wall and your knees and hips bent at a 90-degree angle.
2. Inhale through your nose and exhale through your mouth performing a pelvic tilt so that your tailbone is raised slightly off the mat. Keep your back flat on the mat.
3. Maintain your hip lift with your left leg on the wall and straighten your right leg.
4. Slowly take your straight right leg on and off the wall as you breathe in through your nose and out through your mouth. You should feel the muscles behind your left thigh engage.
5. Perform 3 sets of 10 repetitions, 1-2 times a day.



Figure 8