Postural Priorities-

Rib Cage Influences on the Volleyball Player's Shoulder

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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.

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The game of volleyball is a myriad of highly specific and technical skills that require and demand neutral resting position of the thorax or rib cage. When most athletic trainers, conditioning specialists, and coaches consider a volleyball conditioning program, particularly for the shoulder, the position of the rib cage is not considered first or at all.

The purpose of this discussion is to provide the reader with a basic understanding of ribcage mechanics and the influence of rib position on the congruence of the scapula thoracic joint. Once the reader can appreciate the concept of the ribs directing the shoulder blade, and thus directing muscle force couples around the rotator cuff, they will be able to understand why some athletes have a great tendency toward shoulder injury. They will also be able to identify those athletes and implement appropriate strategies into their training regimens. In succession to this introductory discussion will be a specific application of correct rib cage mechanics to two crucial skill sets in volleyball; blocking and attacking.

What is the definition of neutral rib cage resting position?

If the members of a volleyball team were instructed to stand shoulder to shoulder in a straight line with their arms at their sides, it would appear that the thorax of all players was neutral, facing straight ahead. Despite appearances, the bony rib cage may or may not be in a neutral resting position. Neutral rib cage position can be defined as a state in which the bony anatomical midline is parallel with the frontal plane and the ribs are in a state of neutral rotation. In other words, they are neither internally nor externally rotated.

What is rib rotation?

Rib rotation provides the physiological means by which the lungs and thorax inflate and deflate during respiration. During inhalation the ribs are externally (posterior) rotating as the diaphragm contracts with the result being elevation of the ribs in the front of the athlete and depression of the ribs in the back. The opposite is true during exhalation. The ribs are internally (anterior) rotating in the sagittal plane around a medial-lateral axis, as the diaphragm returns to its cylindrical domed-shape.

Rib rotation also accompanies motion of the thoracic spine in all three planes. The ribs internally rotate when the trunk flexes. The ribs externally rotate when the trunk extends. Trunk rotation to the left requires external rotation of the left ribs and internal rotation of the right ribs. Trunk rotation to the right requires external rotation of the right ribs and internal rotation of the left ribs.

What is the typical resting position of the volleyball player's rib cage and why?

In the typical right arm dominant volleyball player, the midline of the rib cage (i.e. sternum) is oriented to the right. In other words the anterior surface of the sternum and ribs is facing to the right. The ribs on the left are externally rotated, and the ribs on the right are internally rotated.

The reasons for this are many, but mainly have to do with asymmetry in the right and left muscular chains of the thorax. These muscle chains are polyarticular in nature and are composed of several muscles functioning as a unit. The bony attachments of the adjacent muscles in this chain are extensively intertwined, thus the position, length tension, and tone in one muscle strongly influences the function of the other. These chains are comprised of the diaphragm and the psoas and they significantly influence respiration and rotation of the spine and rib cage. If the left chain overpowers the right chain 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 center of gravity over the right hip. 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 compensatory mechanics is on rib alignment and position because most athletes with a forward left pelvis compensate with trunk rotation to the left, which as earlier explained, results in the left ribs being externally rotated and the right ribs internally rotated.

How is the position and function of the right shoulder altered when the ribs beneath the right shoulder remain internally rotated?

Unfortunately, in many competitive volleyball players, shoulder problems arise when scapular thoracic congruence is lost. In other words, the concave anterior surface of the scapula no longer has a convex rib surface to line up with. The convexity is lost because the internally rotated right ribs direct the scapula into a protracted position. With the scapula protracted, the length tension relationships of the posterior scapular stabilizers are altered and the mechanical advantage of the lower trapezius, rhomboids, and serratus anterior is ineffective for providing stabilizing force couples to retain the scapula on the thorax during high velocity rotation of the shoulder joint. In addition the subscapularis muscle, a key internal rotator of the shoulder during the volleyball attack, also becomes ineffective when a rib directed scapula remains passively protracted.

In the protracted state, the latissimus dorsi becomes recruited to act as a powerful internal rotator for the volleyball attack. This compensatory overuse leads to strong anterior rib cage elevation

which further reinforces the pattern of shoulder protraction. Shoulder protraction leads to upper trapezius tension, bicipital tendonitis, and impingement. When the athlete attacks and makes contact with the volleyball, the scapular thoracic muscles stabilize the shoulder blade. The only scapular stabilizer that can appropriately function in this situation is the anterior scapular muscle, the pectoralis minor. The compensatory overuse of the pec minor pulls the humeral head forward via the scapula. The anterior shoulder capsule and the overlying biceps tendon are now placed in a lengthened position. This lengthened position of the biceps tendon promotes excessive eccentric loading of the biceps muscle, particularly during follow through phase of the volleyball attack swing. Tendonitis is usually the initial problem, but if a volleyball player continues to play at a very competitive level using the compensatory mechanics that were just discussed, more serious shoulder pathology can develop.

How can volleyball players with poor rib cage position be identified?

Simply observing the shoulder and scapular position on an athlete standing with their back exposed will help trainers identify those athletes with dysfunctional scapular thoracic motion and resting position. In many right arm dominant athletes the right shoulder will appear depressed, and the scapula will appear protracted, or forward with respect to the left scapula, and winged. (Figure 1)

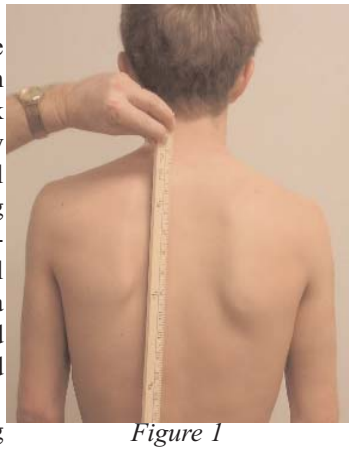

Figure 1

Trainers and conditioning coaches can easily perform two simple tests to determine if faulty rib cage and shoulder mechanics exist in an athlete. If the rib cage is not positioned in a neutral resting position, the athlete will demonstrate significant asymmetry, left vs. right, in the passive range of motion of shoulder internal rotation and shoulder horizontal abduction, assuming that the integrity of both the left and right shoulder capsules are intact. There are situations in which horizontal abduction and internal rotation of the athlete's shoulder is significantly limited bilaterally. This is not the predominant pattern, and for simplicity the mechanics have not been included in this discussion.

When the athlete is placed in a supine position and the left arm is brought into 90 degrees of abduction and then horizontally abducted off the side of a table, the left shoulder will demonstrate an apparent 30 to 50 degree limitation when compared to the range available to the right shoulder (Figure 2). The reason for this limitation is not a shoulder capsule or pectoralis muscle restriction, rather the orientation of the rib cage and sternum to the right has already taken up 30 to 50 degrees of the available range for this motion.

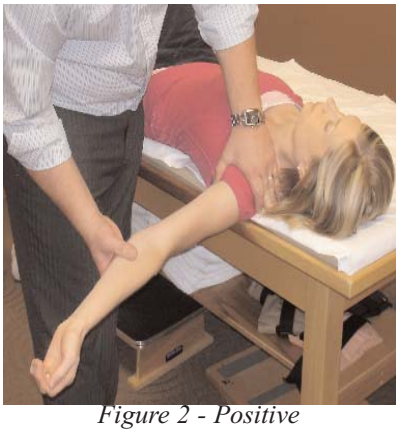

Figure 2 - Positive

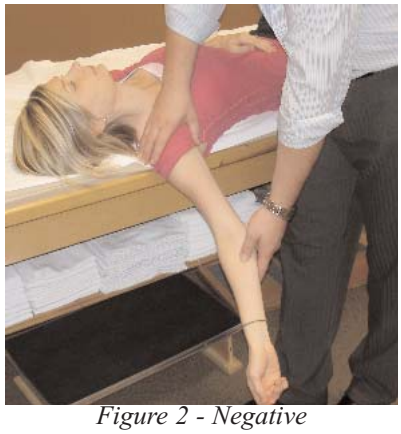

Figure 2 - Negative

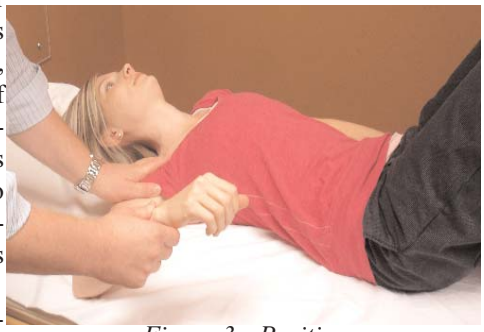

Figure 3 - Positive

When the athlete is placed in a supine position and the right arm is brought into 90 degrees of abduction and passively internally rotated, the right shoulder will demonstrate an apparent 30 to 50 degree limitation when compared to the range available to the left shoulder (Figure 3). The reason for this limitation is not a shoulder capsule or rotator cuff restriction. The compensatory trunk rotation to the left, resulting in the right ribs remaining internally rotated, directed the scapula into a protracted position. The humeral head will not be able to fully internally rotate in this position secondary to posterior superior humeral glenoid impingement.

Figure 3 - Negative

How can an athlete's rib cage and scapula be restored to optimal resting position?

The initial treatment or training focus should be re-establishment of left diaphragmatic breathing so that symmetrical and reciprocal diaphragmatic breathing will occur during training and competitive play. The left and right diaphragms are the primary respiration muscles, and are part of the left and right muscular chains of the thorax. When the diaphragm contracts the ribs externally rotate. If the left ribs remain externally rotated as is the case in the typical right arm dominant volleyball player, the left diaphragm cannot effectively contract for apical lung expansion. Isolated training of the left diaphragm will restore neutral rib cage position. (Figure 4 and Figure 5)

Figure 4

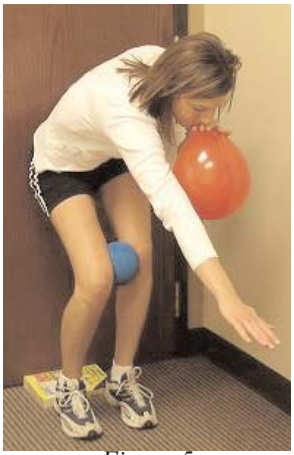

Figure 5

The second training focus should integrate diaphragmatic activity, particularly on the left, with highly dynamic scapula thoracic activity on the right provided by the serratus anterior, lower trapezius and triceps so that the strength needed for scapular stabilization during arm swing can be

restored. (Figure 6, Figure 7 and Figure 8)

Figure 6

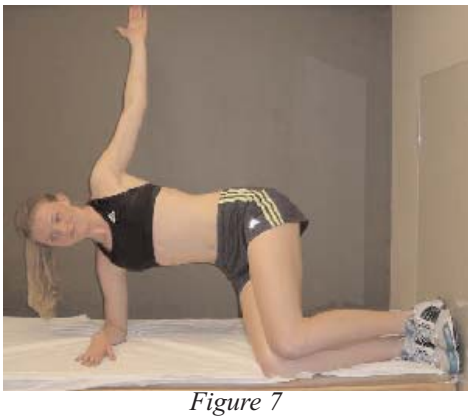

Figure 7

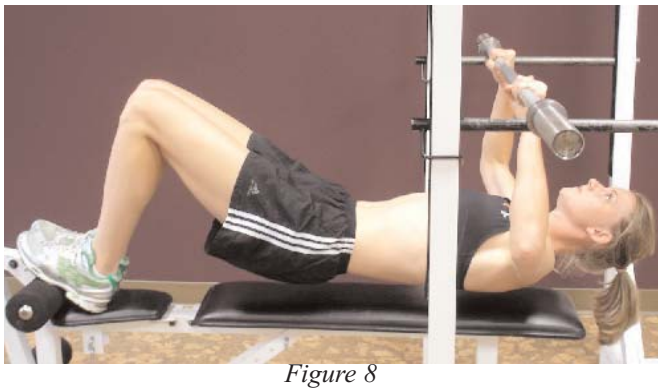

Figure 8

The third training focus should integrate shoulder internal and external rotation motions provided by subscapularis activity integrated with appropriate scapula thoracic activity. (Figure 9 and Figure 10)

Summary

Many volleyball athletes are hindered in their ability to compete and train at the level they prefer due to chronic shoulder pain. Poor suboptimal rib cage and scapular mechanics precedes shoulder dysfunction and pain. This biomechanical discussion was a very general overview, but hopefully at this point the reader has an increased appreciation for ribs and their relationship to the scapula and shoulder. Following this introductory article, a more specific explanation of required rib cage and scapular mechanics for effective blocking and attacking will be provided in two different discussions.

More Information Please!

Please note that techniques provided in Figures 4 through 10 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. O

Exercise Technique Descriptions
Figures 4-10

90-90 Hip Lift with Right Arm Reach and Balloon (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. Place a 4-6 inch ball between your knees.

3. Place your right arm above your head and a balloon in your left hand.

4. Inhale through your nose and as you exhale through your mouth perform a pelvic tilt so that your tailbone is raised slightly off the mat. Keep your low back flat on the mat. Do

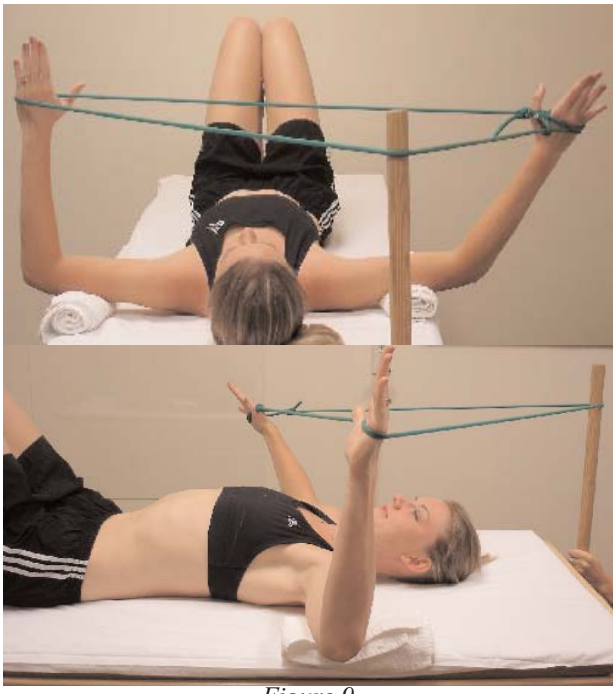

Figure 9

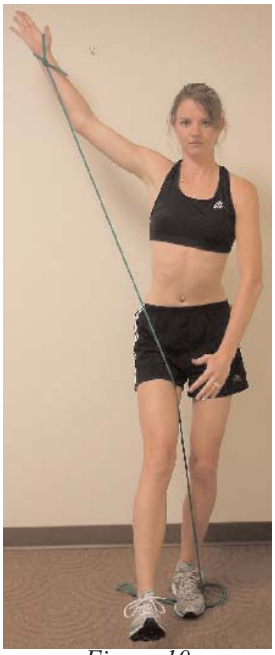

Figure 10

not press your feet flat into the wall instead dig down with your heels.
5. Place your right hand straight up in the air and place a balloon in your left hand.
6. Take a deep breath in through your nose, as you exhale into the balloon reach towards the ceiling with your right arm.
7. Hold this position and 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 and exhale into the balloon while reaching further towards the ceiling with your right arm.
9. Hold this position and pause 3 seconds.
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 your arm and pelvis and repeat the sequence 4 more times.

PRI Wall Squat with Balloon (Figure 5)
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.
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. Do not strain your neck or cheeks as you blow.
10. Inhale again through your nose. Slowly exhale into the balloon as you reach further with your right arm.
11. You should feel a stretch across your right chest wall. You will also feel your left abdominal wall and your left outside hip engaging.
12. After your fourth inhalation, pinch the balloon neck, remove it from your mouth and let the air out as you slowly stand up.
13. Relax your legs and repeat sequence 4 more times.

Paraspinal Release with Left Hamstrings (Figure 6)
1. Place both of your palms on a 3-4 inch block and place your feet directly in front of you.
2. Pull your shoulder blades down and together.
3. Dig both of your heels into the floor and push down with your arms lifting your hips off the floor. You should feel the muscles on the back of your thighs and shoulder blades engage.
4. Once your hips are in the air, round your back by tucking your bottom up.
5. Continue to dig both of your heels into the floor as you move your hips slightly forward or away from the block.
6. Keeping your hips forward and your shoulders pulled together, pick your right foot off the floor. You should feel the back of your left thigh engage.
7. Hold this position while you take 4-5 deep breaths in through your nose and out through your mouth.
8. Relax and repeat 4 more times.

Sidelying Trunk Lift (Figure 7)
1. Lie on your right side with your hips and knees bent at a 90-degree angle.
2. Prop your trunk up on your right forearm keeping your elbow directly below your shoulder.
3. Press your left knee down into your right and pull your right shoulder blade down and back.
4. Keeping your right shoulder blade pulled back, slowly raise your right hip up and off the mat. You should feel the muscles in the back of your right shoulder blade engage.
5. Maintaining the above position, raise your left arm up above your head and take 4-5 deep breaths in through your nose and out through your mouth.
6. Slowly lower yourself back down to the mat and repeat 4 more times.

Bench Hooklying Thoracic Pull Ups (Figure 8)
1. Lie on a bench with your knees bent and your hands gripping a bench press bar.
2. Pull your shoulder blades down and together.
3. Inhale through your nose and exhale through your mouth performing a pelvic tilt so that your tailbone is raised slightly off the bench. Keep your back flat on the bench.
4. Keeping your shoulder blades pulled down and your hips raised slightly off the mat, begin to pull your body towards the bar. Keep your back and neck straight with your trunk as you come up. You should feel the muscles in the back of your shoulder blades engage.
5. Hold this position while you take 4-5 deep breaths in through your nose and out through your mouth.
6. Relax and repeat 4 more times.

Supine Resisted Right Tricep Extension with Right HG IR (Figure 9)
1. Lie on your back with your knees bent.
2. Bring your arms to shoulder level and rest them on bol-

sters.
3. Bend both arms at a 90-degree angle.
4. Tie a piece of tubing into a knot and anchor it around a post directly above your right hand.
5. Place both hands inside the loop. The tubing should form a triangle.
6. Pull your shoulder blades down and together and turn both palms so that they are towards your feet.
7. Keeping your left hand stable, begin to straighten your right elbow against the resistance of the tubing. You should feel the muscles in the back of your right shoulder blade and the back of your right arm engage.
8. Maintaining the above position, begin to turn your right hand down towards the surface of the mat. You should feel the muscles in the back of your right shoulder engage.
9. Hold this position while you take 4-5 deep breaths in through your nose and out through your mouth.
10. Relax and repeat 4 more times.

Standing Resisted Right Diagonal Flexion in PRI Right AIC Single Leg Vertical Balance (Figure 10)
1. Place a piece of tubing underneath your left foot and place the other end in your right hand.
2. Shift your hips to the left and sidebend your trunk to the left.
3. Pull your shoulder blades down and together.
4. Begin to raise your right hand up and out to the side as you rotate your palm up. You should feel the muscles in the back of your right shoulder blade engage.
5. Lift your right foot in front of you.
6. Try to balance on your left leg as you reach forward and across the midline of your body with your left hand.
7. Hold this position while you take 4-5 deep breaths in through your nose and out through you mouth.
8. Relax and repeat 4 more times.