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## The Optimal Shoulder

Strong shoulders are the key to performance overhead, and four simple movements can help you improve mobility and stability.

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A look back at the workouts from CrossFit.com for the 2013 year reveals that over 80 percent of them involved at least one exercise that had a transfer of force through the shoulder girdle. Therefore, proper function of the shoulder is critical for both optimal performance and injury prevention. An examination of the functional anatomy of the shoulder can provide insight as to what is required of the shoulder and how we can prepare it for athletic movement.

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### Functional Anatomy of the Shoulder Complex

The shoulder, or glenohumeral joint, is a ball-and-socket joint. The socket of the scapula is known as the glenoid. Unlike the hip socket, which is quite deep, the glenoid is relatively flat and not large. The shoulder joint is often compared to a golf ball on a tee to illustrate that the majority of the glenohumeral joint's stability does not come from bony approximation. Instead, four muscles collectively referred to as the rotator cuff provide dynamic stability to the glenohumeral joint.

The supraspinatus sits on the top of the shoulder joint, and it keeps the humerus pulled close to the glenoid, contributes to the external rotation of the joint and abducts the shoulder. The infraspinatus and teres minor make up the posterior rotator cuff and provide the majority of external-rotation torque to the shoulder. They also exert an inferior pull on the shoulder during elevation. This pull prevents the humeral head from sliding upward due to the pull from the deltoid muscles, which would result in impingement of the structures between the humeral head and acromion. The subscapularis originates on the front side of the scapula and both compresses and internally rotates the glenohumeral joint (8). The deltoids are superficial to the rotator-cuff muscles and work to flex, abduct, extend and rotate the shoulder.

Movement and stability of the scapula are equally important to shoulder function. Proper scapula movement is important for providing a stable base for the glenohumeral joint. When raising the arm overhead, shoulder elevation comes from both the humerus moving on the glenoid and the scapula rotating upward. The scapula should move approximately 1 degree for every 2 degrees of humeral movement. This upward rotation of the scapula comes from a balance of muscle activity between the upper trapezius, lower trapezius and serratus anterior muscles. Proper functioning of these muscles is important for lifts such as overhead presses. Other exercises, such as rowing, and proper posture rely on strength in the rhomboids and traps, which produce scapular retraction (8).

Another important role of the scapula is to transfer forces from the legs and trunk to the upper extremities. For example, studies on the tennis serve show that over 50 percent of the total kinetic energy and force is generated in the trunk and lower extremities. These forces are then transferred through the scapula to the arm (4). This is also seen in a variety of frequently used CrossFit

exercises—such as thrusters and jerks—in which the legs provide large amounts of force that is then transferred through the body to the shoulders and arms to complete the movement.

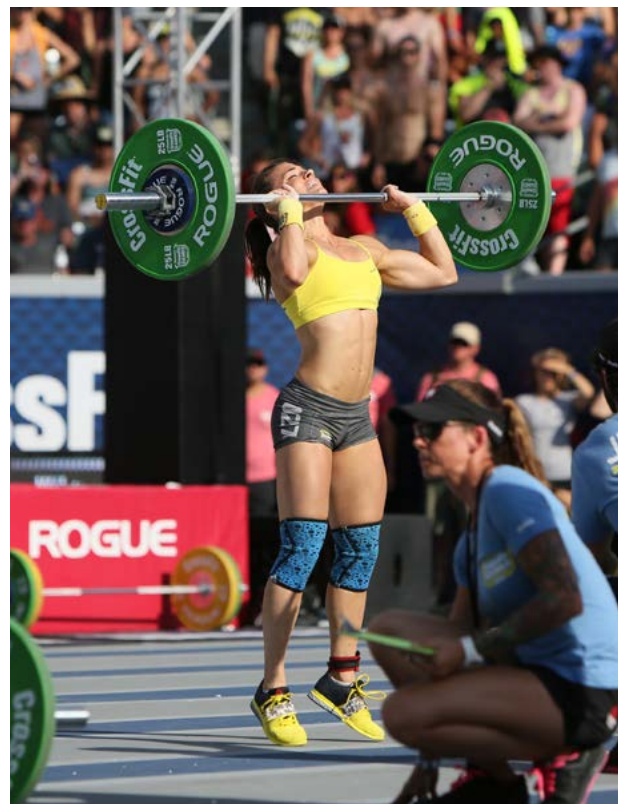
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### Imbalances of the Shoulder Complex

Shoulder imbalances can decrease an athlete's performance and increase risk of injury. Imbalances can place unnecessary levels of stress on tissues; therefore, it is



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*In a push press, the scapulae transfer force generated by the lower body to the shoulders and arms.*

vital that an athlete maintain a stable muscular base around the shoulder while also maintaining adequate mobility in order to decrease the risk of injury. The need to address both mobility and stability cannot be emphasized enough.

Mobility issues should be addressed before stability. But after gains in mobility, stability work should follow. If mobility is not improved, stability problems should be examined. Oftentimes, lack of mobility can actually be the result of a stability problem as the body decreases mobility in an attempt to create artificial stability (2). An easy example can be seen in a standing hamstring stretch. An athlete's mobility in this movement can often be improved by having him or her squeeze a ball between the knees. This squeeze increases core activity (stabilization) and often allows the person to reach farther.

In order to understand how to prevent or reverse muscle imbalances, we must first understand why they are so common among athletes and members of the general public. Functionally, muscles have been classified as "tonic" and "phasic." The tonic muscles are prone to tightness, and the

phasic are prone to weakness or inhibition (7). With a predisposition to weakness in our phasic muscles, it is of utmost importance to maintain proper strength in these muscles while maintaining proper length in the tonic muscles.

**Table 1**

Tonic Muscles	Phasic Muscles
Pectoralis major	Serratus anterior
Upper trapezius	Rhomboids
Levator scapulae	Lower trapezius
Scalenes	Deep neck flexors
Sternocleidomastoid	Upper-limb extensors
Upper-limb flexors	



***A functional shoulder is characterized by both strength and mobility. Both must be maintained for optimal performance.***

As previously discussed, proper scapula movement and stability during overhead activities occur as a result of the coordinated activity of the upper trapezius, lower trapezius and serratus anterior. Numerous studies have suggested altered scapular rotation and higher activity in the upper trapezius compared to the lower trapezius and serratus anterior are commonly seen in multiple shoulder pathologies (3,4,5). This imbalance falls in line with patterns of tonic vs. phasic muscles. Clinically, retraining muscle activity and proper scapular movement can be troublesome, and exercises that provide little opportunity for compensation are best suited to the task.

From a standpoint of pure sports performance, muscles cannot develop maximum levels of torque absent a stable base, leading to decreased strength. Calculations performed by Kibler found that as little as a 20 percent decrease in energy delivered by the hip and trunk results in a need for 80 percent more mass or 34 percent more rotational velocity in the shoulder joint to produce the same levels of force through the upper extremities. This huge increase in shoulder workload due to an unstable base will not only decrease the efficiency of the entire system during a movement such as a push press but will also likely overload the shoulders, potentially leading to overuse injuries (4).

One area of imbalance that is common in athletes is an overworked or fatigued rotator cuff. In a study performed by Chopp et al., it was found that continuous overhead work accelerates rotator-cuff fatigue. If the rotator cuff

is fatigued, the humeral head may migrate superiorly, narrowing the subacromial space, thus putting the athlete at greater risk for subacromial impingement (1). With continuous overhead motion, a strong rotator cuff is a key element in preventing injury or decreasing the likelihood of injury.

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**Strengthening the rotator cuff itself will help keep the humeral head properly positioned on the scapula during shoulder movements.**

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Increasing activation of the phasic muscles will create a more stable base for the entire shoulder complex. This will help decrease strain on the multitude of structures within the shoulder, such as the rotator cuff. Strengthening the rotator cuff itself will help keep the humeral head properly positioned on the scapula during shoulder movements.

### Exercises for Improving Shoulder Balance

The following are exercises we believe to be excellent tools for both decreasing injury risk and addressing common imbalances in the shoulder complex that prevent maximum movement efficiency during high-intensity exercise.



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*On the left, the athlete has locked out the elbows with little protraction of the shoulders. On the right, she has been cued to “push the spine toward the ceiling,” resulting in shoulder protraction and greater activation of the serratus anterior and subscapularis.*

### Push-Ups

Fortunately for CrossFit athletes, one of the best exercises for strengthening the serratus anterior is commonly performed in CrossFit workouts. The push-up has been shown to significantly activate this muscle (9). Performance of a push-up with “a plus” will further activate both the serratus anterior and the subscapularis muscle. A normal push-up generally focuses on elbow lockout, and the plus portion can be added by protracting the shoulders—sliding the scapulae forward on the rib cage at the top of the rep (8). The push-up with a plus (or simply the plus portion of the movement) can be performed by itself as part of a pre-hab program, as performance of the entire push-up-with-a-plus movement during a workout would greatly reduce speed.

### Bilateral External Rotations, aka Shoulder W's

One highly effective injury-prevention and rehab exercise is the bilateral external rotator, or shoulder W. This exercise is performed by holding a resistance band with the elbows against the sides, the forearms directed in front and the palms facing up. Once you are set up properly, externally rotate your shoulders by moving your hands apart while keeping the elbows near the body. This external rotation is coupled with scapular retraction by pulling the shoulder blades toward each other. The shoulder W is effective because it provides good activation of the lower trapezius with lower levels of upper-trap activation. A good ratio of lower-trap-to-upper-trap activation makes this movement a great choice for those who are upper-trap dominant, and it has the added benefit of strengthening

the posterior rotator cuff due to the external rotation of the shoulder (6). For the shoulder W, we recommend 20-30 reps performed as part of your warm-up.

### Face Pull Y Press

The face pull Y press (FPYP) is great for injury prevention and performance as well. Begin with your arms straight in front of you while holding onto a resistance band (rings or a cable column work as well). Next, pull your arms back so your elbows are at shoulder height and your forearms remain parallel to the ground. Externally rotate your shoulders, positioning the forearms at vertical with your elbows remaining level with the shoulders. Push your arms up, creating a Y with the arms overhead before returning to the starting position. To perform the FPYP with rings, assume the same starting position as used with ring rows, but use a stance that places the torso in a more vertical position. Then perform the same shoulder movements described above.

The FPYP is effective because it works the external rotators of the shoulder while also stressing the phasic scapular muscles (see Table 1), such as the rhomboids, lower traps and serratus anterior. Both of these muscle groups are important for injury prevention because they help maintain proper scapula positioning while strengthening the rotator cuff. Most importantly, the top of the FPYP resembles the position seen in many of the overhead lifts performed in CrossFit. Strengthening the stabilizing muscles in this position will translate to better performance in press variations and exercises such as the snatch. Perform 2-3 sets of 10-plus repetitions with



*The shoulder W combines external rotation with scapular retraction, activating the lower trapezius and strengthening the rotator cuff.*

## Optimal Shoulder ... (continued)

a steady tempo. For those really working on overhead stability, pause at the top of the Y for a moment before returning to the starting position.

### Reach, Roll and Lift

This exercise is excellent because it challenges both mobility and stability in the overhead position with little chance of compensations from other muscles or joints. The reach, roll and lift will also facilitate activation of the lower traps and serratus muscles.

Begin in a quadruped position (on all fours) and rock back until your heels meet your butt. Make a fist with one hand and place your forehead on top of it. Put your opposite arm in front of you and reach forward as far as possible while relaxing the other side of the body. Reach forward,

roll your thumb up toward the ceiling, depress the shoulder blade by pulling it downward and lift the arm. Be sure to keep the elbow as straight as possible throughout the movement.

This exercise is deceptively difficult and can frequently expose limitations in mobility of the shoulder complex and weaknesses in the strongest athletes. Perform 2 sets of 10 reps, keeping the elbow as straight as possible and ensuring the shoulder blade is depressed prior to lifting. Most athletes are unable to maintain full elbow extension initially. Make progress in this exercise by increasing elbow extension and then increasing repetitions. An athlete with good mobility and stability of the shoulder complex can perform 20-plus perfect reps.



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*The face pull Y press works the external rotators and also targets phasic muscles such as the rhomboids and serratus anterior. Note how the final position resembles the overhead position seen in many lifts.*

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***In the reach, roll and lift, movement should occur only at the shoulder joint. The set-up position is designed to eliminate compensatory movement patterns such as arching the back. Many athletes will find this exercise exceptionally difficult.***

This exercise makes a great follow-up to mobility work as well. For example, take an athlete with slightly limited shoulder flexion who stretches and gains full motion. After gaining this motion, it is important to challenge the stability in the newly available range to help maintain these gains (2). While a shoulder press may be a good option for this purpose, it still provides multiple levels of potential compensatory patterns such as an excessively arched back. The reach, roll and lift may be a better follow-up for many as it provides less opportunity for compensation and is therefore better in helping maintain this improved motion.

### **Mobility and Stability**

The shoulder is a complex anatomical structure, and proper mobility and stability must be in place for the joint

to perform most efficiently and without increased risk of injury. Rehab and pre-hab work is highly recommended for any athlete looking to improve or maintain shoulder health and function.



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