A previous report in the November, 2010 issue of ATT (“The Windmill Softball Pitch: Optimal Mechanics and Pathomechanics of Injury”) highlighted the importance of gluteal activation throughout performance of the windmill pitching motion. Gluteal activation facilitates pelvic stabilization and efficient energy transfer from the lower extremity to the upper extremity. A proper sequence of muscle activation is necessary to deliver the windmill softball pitch (WSP) in an efficient manner. The “kinetic chain” concept refers to a series of interdependent mechanical links between body segments. In addition, a neuromuscular linkage exists, which involves a relationship between activation of the core musculature and the activation pattern of muscles that control movement of the extremities. Research has demonstrated that muscles in the lower extremity and trunk are activated prior to the initiation of upper extremity volitional movement. On the basis of these concepts, a strength and conditioning program has been developed for windmill softball pitchers.

**Conceptual Basis for Exercise Program**

The strength and conditioning program is based on upper and lower extremity muscle activations that have been documented to occur during performance of the WSP. The gluteal muscle group has been found to have the greatest high level of activation throughout the entire WSP delivery sequence. The greatest gluteal activity occurs during phases 1–4. The gluteal muscles maintain pelvic stability throughout the stride phase, which facilitates efficient energy transfer to the upper extremity for acceleration and release of the ball. Many of the exercises involve activation of the gluteal and hamstring muscles prior to initiation of other movements, because movements of the upper extremity are preceded by controlled movements of the lower extremity and core. Awareness of body position and postural control are important aspects of proper exercise performance.

Postural awareness is enhanced through development of neuromuscular engrams of movement patterns. If the athlete performs exercises with improper postural positioning, she will accentuate poor mechanics in her WSP delivery. All of the exercises are...
designated to activate the gluteal muscle group, which is a major stabilizer of the lumbo-pelvic-hip complex. Evidence suggests that poor stability of the lumbo-pelvic-hip complex is associated with a predisposition to injury.\textsuperscript{7-13} The athlete should first perform isometric exercises with maintenance of a neutral pelvic position, which will enhance awareness of postural position during subsequent performance of dynamic multidirectional exercises.\textsuperscript{14} Isometric exercises should be performed for 10 to 30 seconds.\textsuperscript{15,16} Neutral pelvic positioning can be achieved by “hollowing” the abdomen.\textsuperscript{16} When the athlete becomes fatigued and unable to maintain a neutral position, increased lumbar lordosis will be evident. If the athlete cannot maintain a neutral pelvic position during performance of isometric exercises, she should not progress to dynamic exercises. Some type of biofeedback should be provided, such as a mirror, to assist the athlete in maintaining proper postural positioning. As little as two minutes per day of postural control isometric exercise, performed twice per week for four weeks, has been found to provide a beneficial effect.\textsuperscript{16}

Typical isometric exercises for development of core stability include front-plank and side-plank positioning.\textsuperscript{17,18,19} If the athlete is unable to maintain the position for 30 seconds, she should reposition to finish the 30-second period. Once the athlete is able to maintain the front-plank position, she should progress to an isometric hold with contralateral arm and leg extension (Figure 1). Hip extension should be performed prior to contralateral arm extension. Failure to maintain a neutral pelvic position will be revealed by lowering of one side of the pelvis and an inability to maintain straight alignment of the body. The contralateral positioning of the upper and lower extremity segments requires cocontraction of core and extremity muscles. Progression to a “bird dog” exercise that involves contralateral upper and lower extremity movements will further enhance neuromuscular control (Figure 2). WSP delivery requires pelvic stability during the transition from double-leg support to single-leg support, and back to double-leg support. When performing the “bird dog” exercise, there is coactivation of the hip extensor, multifidus, and longissimus muscles, which is followed by activation of the scapular stabilizers and shoulder flexors.

**Dynamic Strengthening Exercises**

After the isometric exercises can be correctly performed, the athlete should be progressed to isotonic exercises that activate the gluteal muscles. The gluteus medius is most effectively activated by resistance to hip abduction, which can be performed in a side-lying position with hips and knees in 90 degrees of flexion (Figure 3). During the stride phase of the WSP, the gluteus medius of the non-weight-bearing extremity must be activated to effectively transfer energy through the kinetic chain to the upper extremity.\textsuperscript{1,6,15,16}

Elastic tubing can be configured in an X-pattern between the feet and hands to simultaneously provide resistance to the lower and upper extremities (Figure 4). While keeping the knees fully extended and the feet

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**Figure 1** Front-plank isometric exercise with contralateral leg and arm extension.

**Figure 2** “Bird dog” exercise.

**Figure 3** Side-lying hip abduction exercise.
at shoulder width, the athlete takes two-inch steps. The hands should be maintained at shoulder height, with scapulae maintained in a retracted and depressed position. This exercise provides simultaneous resistance to muscles that stabilize the pelvis and the scapulae, which must be activated to provide a stable platform for shoulder movement during WSP phases 2 and 3.2,3,20,21

Bridging pelvic tilts are performed with one extremity maintained in a position of hip flexion, while actively flexing and extending the contralateral hip. As the athlete extends the contralateral hip, the pelvis should be maintained in a neutral position (Figure 5). For progression of exercise difficulty, the athlete can use a bench to generate a greater range of active hip flexion and extension (Figure 6). If the pelvis is not maintained in a neutral position at any point in the performance of the hip movement, the exercise should be stopped and the athlete should be prompted to reposition the pelvis. During WSP delivery, pelvic stability is particularly important during the period of single-leg support to ensure adequate energy transfer from the lower extremity to the upper extremity.

If the athlete does not have adequate gluteus maximus strength, she will not be able to raise the leg off the floor when performing the advanced “bird dog” exercise (Figure 7). This exercise can be performed in an isometric manner, but it is more effective in improving pelvic stability when performed in a dynamic manner with active extension of the hip. The athlete should extend the hip as high as possible and then lower the leg to the floor in a controlled manner. The advanced bird dog should not be performed unless the individual can perform the basic bird dog exercise with maintenance of the pelvis in a neutral position.
Another exercise for development of pelvic stability involves maintenance of single-leg postural balance while extending the contralateral hip. Hip flexion of the weight-bearing extremity should not occur before active hip extension of the contralateral extremity has been initiated. This exercise focuses on activation of the gluteus maximus in the extremity that is lifted, while the gluteus medius of the weight-bearing extremity is activated to maintain the pelvis in a neutral position. The difficulty level of this exercise can be increased with the addition of a weighted ball catch/toss or simultaneous performance of upper extremity diagonal movement patterns, which will enhance the ability to maintain a neutral pelvic position during utilization of the upper extremity with single-leg support (Figure 8a, 8b). Once the athlete is capable of performing this task, she will be ready for sport-specific movement patterns.

The Bodyblade® (Mad Dogg Athletics, Venice, CA) is an ideal tool for creation of micro-perturbations within the kinetic chain during the performance of functional movement patterns. Such activity may enhance neuromuscular coordination throughout the kinetic chain, which will enhance WSP performance and reduce injury risk.\(^\text{22}\)

**Summary**

Activation of the gluteal muscles for stabilization of the lumbo-pelvic-hip complex is an important aspect of all functional movements that involve energy transfer from the lower extremity to the upper extremity.\(^{1,12,18}\) During performance of each of the recommended exercises, the athlete should exhibit proper postural alignment of the pelvis. A focus on enhancement of the performance of the gluteal muscles may decrease susceptibility to injury related to WSP delivery.\(^{1}\)

**References**


Gretchen Oliver is an assistant professor and Clinical Coordinator of the entry-level Graduate Athletic Training Education Program at the University of Arkansas in Fayetteville.