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The Transversus Abdominis and Reconditioning the Lower Back

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MANY INDIVIDUALS SUFFER lower-back pain at one time or another during their life. In fact, statistics show that nearly 80% of Americans will experience some sort of lower-back pain at least once in their lifetime (2). It is one issue to attempt to uncover the reasons for this statistic and yet another to devise an exercise program that could address the problem. Exercise reduces the risk of many ailments, including lower-back pain. The general population already accepts that exercise would benefit them in many facets of their life. However, many issues stand in the way of the implementation of exercise into one's life. Among these issues is lack of knowledge, which leads to exercise avoidance, as well as an unrealistic concept of the time loss one would suffer if exercise were implemented. Another factor leading to little or no exercise is pain avoidance. These factors often derail the subject's exercise program before it even begins.

Conditioning programs can benefit those with lower-back pain as well as those who wish to avoid it. This article describes first the developmental aspects of lower-back pain, and then how the lower back can be stabilized and strengthened to reduce or even altogether eliminate lower-back pain. These dynamic exercises, designed to reverse the deconditioning process, can be used in any program, enabling virtually anyone to achieve such a goal. I will demonstrate how these exercises can be applied as a warm-up in a standard tae kwon do class; however, we are not limited to the martial arts when we consider the application of such a program. I have been using this warm-up in baseball, basketball, and soccer and even with swim teams for several years now with positive feedback from the coaches and players.

■ The Deconditioning Process

"Deconditioning syndrome" can be identified in most clients with chronic or recurrent back pain by the presence of immobility, muscle weakness, and pain-avoidance behavior (5). Any one of these factors can lead to problems that can reduce performance and cause or increase pain. The process can begin many different ways, but it always includes some source of repetitive strain.

The process of loading tissues has been charted to demonstrate the relationship between strain (percentage elongation or deformation) and stress (volume of loading). Each tissue has its own set degree of deformation and its own amount of stress load. Only 4% total muscular deformation—that is, strain—is needed to initiate microinjury (7). Once microinjury occurs in the muscle tissue, the ability of the tissue to sustain further stress is reduced because of rearrangement of tissue collagen, or scar tissue. Once this scar tissue infiltrates the muscle, the muscle's ability to return to resting length is reduced. When a muscle can no longer return to its resting length, its ability to withstand prolonged or repetitive loading and unloading decreases, and more serious muscle damage is possible. The client in this state will feel vulnerable and develop intolerance to even normal activities of daily living. These individuals will say they cannot work out because of pain and will begin to reduce their general activity level. The truth of the matter is that if they do not do something, further disability is inevitable.

What might these individuals expect? They might expect a gradual decline in their fitness level and a deterioration of performance and desire. Jull and Janda (4) and Hodges and Richardson (3) have shown that certain muscles are prone to tightness or weakness because of the lack of movement variation in individuals' daily lives. Prolonged, static, overstressed muscles in sitting and standing postures are not uncommon in a mechanized industrial society (11). These postures contribute to further deconditioning only if countermovement is not implemented. For example, as the lower-back extensors, hip flexors, and the hamstring muscles become tight in the seated posture, the abdominals and gluteus maximus become weak from lack of use. It would be beneficial to apply exercises that would strengthen those muscles that have become weak and stretch the muscles that have become tight, thus slowing, or even avoiding, the deconditioning process altogether.

The exercise program I am proposing is a warm-up designed to address this muscular imbalance and deconditioning process. With consistent implementation of such a warm-up, it is possible to reverse the process and actually recondition the lower back. It is interesting to note that this program would help most of our clients, athletes or nonathletes alike.

Anatomy

Before we go too far, it will be necessary to review the anatomy of the lower torso as it pertains to the deconditioning process. Tables 1 and 2 place several muscles in two basic categories. Jull and Janda (4) found that phasic muscles tend to become weak when not used, and postural muscles tend to become tight with disuse. For the purpose of this article I will be addressing the lower core muscles.

The deconditioning of the lower core muscles described earlier is referred to as "lower crossed syndrome" (Table 3). The hip flexors, erector spinae, tensor fasciae latae, and the quadratus lumborum all tend toward shortening and must be lengthened. The gluteus maximus, abdominals, and gluteus medius tend toward weakness and must be strengthened. Continued shortening of the postural muscles will only lead to further weakening of the phasic muscles on the antagonistic side. For example, many young athletes desire to "bench" heavy weight, and in their pursuit they deemphasize the posterior shoulder and scapular elements, the antagonistic side. If this pattern continues, soon the athlete will begin to "decondition" the shoulder stabilizers, and injury is likely to occur. This can lead to a vicious cycle that can be difficult to stop.

Table 1
Muscles Prone to Tightness

Gastrosoleus
Short hip adductors
Rectus femoris
Piriformis
Erector spinae
Hamstrings
Tensor fasciae latae
Iliopsoas
Tibialis posterior
Quadratus lumborum

Table 2
Muscles Prone to Weakness

Peroneus brevis
Peroneus longus
Peroneus tertius
Vastus medialis
Vastus lateralis
Tibialis anterior
Gluteus maximus
Gluteus medius
Gluteus minimus
Rectus abdominis

Table 3
Lower Crossed Syndrome

Shortened muscles
Hip flexors (iliopsoas)
Erector spinae
Tensor fasciae latae
Quadratus lumborum
Weakened muscles
Gluteus maximus
Abdominals
Gluteus medius

In addressing this issue, particular attention must be placed on the primary stabilizers as they relate to the lower core. Let us discuss briefly the stabilization process. The spine can be likened to a flexible rod; under compressive loading, it will buckle if not stiffened with active muscle (8). Table 4 describes how many trunk muscles contribute to stability (9). However, we must define the primary stabilizers of the spine and how proper training of those muscles can be helpful in assisting the performance of an athlete.

Table 4
Trunk Muscle—Function/Stability

Erector spinae, superficial and deep division
Multifidus
Intersegmental muscles
Quadratus lumborum and psoas
Abdominals
Source: Moore (9).

The abdominals are the primary trunk flexors and rotators, but we often forget about their relationship with lower-back stability. The lumbar muscles alone are poor lower-back stabilizers without the cocontraction of antagonistic trunk muscles (1). The antagonistic muscles that assist in stabilizing the lower back during load are the abdominals, specifically the transversus abdominis (TrA). Thorstensson and Daggfeldt (12), in their study of the role of intraabdominal pressure (IAP) in spinal unloading, recorded electromyogram activity on subjects performing isolated back extensions and lifting tasks. They found that the external oblique and rectus abdominis were silent in most cases. However, the internal oblique and TrA were most active, the TrA being the major contributor (12). Hodges and Richardson (3) studied the response of trunk muscles and their association with movements of the lower limbs in subjects with and without lower-back pain. In the control subjects all trunk muscles preceded the muscle responsible for the limb movement in each direction. However, a delayed reaction of the trunk muscle contraction was found in subjects with lower-back pain. This delay was consistently and most significantly related to the contraction of the TrA (3). If spinal stabilization is established when postural trunk muscles are able to cocontract isometrically in functional situations in order to protect the spinal tissues from excess motion (10), then a delay in this cocontraction, specifically the TrA, may contribute to improper loading of the spine and, therefore, predispose the lower back to injury (3). It may be concluded then that unloading the spine, via proper trunk muscle cocontraction, is the primary goal when trying to prevent injury during exercise. Therefore, careful attention must be given to the TrA.

The traditional sit-up alone does not contribute to the development of lower-back stability by this definition, because a loading and unloading of abdominal and hip muscles occurs (6), losing the constant cocontraction of trunk muscles. Exercises that create the constant contraction of the abdominal musculature, in concert with the latissimus dorsi and the thoracolumbar fascia, create a corset around the spine and thus produce stability. This is accomplished with the closed link, sometimes known as the “hoop” configuration, which describes how the internal oblique and the TrA tie into the posterior thoracolumbar fascia. It has been shown that the TrA may act to convert the lumbar spine into a rigid cylinder, increasing the IAP and maintaining the hooplike geometry of the abdominal muscles, thus increasing the mechanical stability of the spine (3). This may be accomplished with the development of lateral tension in the thoracolumbar fascia. Stability, therefore, is accomplished by the coactivation of trunk flexors and extensors, which creates a mechanical equilibrium within the lower torso (1) and protects the spinal tissues from potential harm.

The Stabilization Exercises

We have reviewed the deconditioning process and have demonstrated lower torso anatomy as it is related to the deconditioning process. In Figures 1–9, core stabilization exercises are presented with instructions. Consult a medical professional prior to beginning this program; each individual should perform these exercises with instruction from and under

Figure 1. **Quadruped.**

Figure 2. **Side thrust.**

Figure 3. **Curl-up.**

Figure 4. **Oblique curl-up.**

the supervision of a qualified professional. Each client should be educated on the proper "firing," or contraction, of the TrA that will place the lower core in a stable position by creating the "hoop" effect.

Contraction of the TrA is achieved by pushing the side of the abdominals outward. This may be the most difficult aspect of learning the core stabilization program, so some time must be given to coaching clients on how to contract their TrA. Those who do not have lower-back pain but have not developed the activation of the TrA may have great difficulty even finding this part of their anatomy. Hodges and Richardson (3) remind us that the TrA is the first of the trunk muscles to activate prior to upper and lower limb movement. This prior activation is regarded as a "feed-forward" postural response, as the trunk seeks core stability prior to limb action (3). To become more aware of the TrA you may perform a brief experiment using this feed-forward activation. Position yourself sitting in your chair upright with your legs in front of you and your feet on the floor. Simply lift 1 foot approximately 3 inches off the floor while maintaining an upright position and feel the reaction of the lower trunk region. When performing this drill slowly, you will determine that the TrA is the first muscle to activate, thus allowing the lower trunk to stabilize prior to lower limb tasks. The feed-forward action of the TrA is delayed in those who suffer chronic lower-back pain (3). This leaves the lumbar region vulnerable to more serious injury and is possibly the main reason why a client may have prolonged lower-back pain in the first place.

The TrA muscle fibers run horizontally around the abdomen from the iliac crest and the inner border of the lower 6 ribs and fascial attachments arising from the spinous and transverse processes of the lumbar vertebrae to the linea alba anteriorly (6, 12). Teaching our clients to contract this muscle may be an involved procedure in and of itself. There are many ways to become more aware of this abdominal muscle: ask clients to sit; place your fingers in the sides of their lower trunk above their iliac crests; ask them to push out against your fingers as you gently push inwardly on their sides. If this does not work, ask them to cough gently while feeling the contraction of the TrA bilaterally with their thumbs. The sitting test described earlier may also be helpful. Any of these methods can be used until the client is able to reproduce the activation of the TrA at will.

Clients can be taught breathing techniques that will enhance their awareness of the function of the TrA. For example, have clients lie on their back with their hands at each side palpating their TrA. Ask clients to breath in and allow their abdominal region to rise. Then, upon expiration, ask them to slowly "fire" their TrA as they flatten their lumbar spine on the floor beneath them. They should hold this position for several seconds. You may also show clients that they are able to continue to contract the TrA independently of their breathing. This will be a goal for all clients and sets the stage for stabilization.

Sport-Specific Training

In most sports, if not all, flexibility, speed, and power are essential to excel in technical aspects. Many are held back from that experience because of lower-back pain, as we have discussed.

Figure 5. **Reverse curl-up.**

Figure 6. **Dynamic hamstring stretch.**

Figure 7. **Piriformis stretch.**

Figure 8. **Psoas/quadriceps stretch.**

Figure 9. **Standing one-leg internal rotation.**

The task is relatively simple and takes only a few minutes. For any program, the core stabilization program just described can act as your warm-up and will take about 8–10 minutes to complete. Stretching drills and further resistance training can be added as necessary with confidence that the lower back is developing stability. However, close attention should be given to the proper "set" positions in various exercises in order to reduce risk of injury and improve the stabilization process. For example, when performing a lateral pull-down, one should maintain a retracted chin for neck stability, scapular retraction for shoulder stability, and a neutral pelvis with TrA contraction for lower core stability. If you perform a lateral pull-down with these factors in mind, you will find the exercise to be more challenging and safe.

Balance is probably the most important skill in martial arts. However, this part of training can seem very difficult or even impossible to some, but not to others. Athletic ability and genetic factors are surely associated with performance, and most will appeal to this concept and accept their "deficiencies." On the other hand, it is possible that athletic performance is reduced when the lower back is deconditioned, thus reducing the student's ability to balance in difficult postures because of instability. The short-foot and standing drills described earlier are designed to increase the balance mechanism as our musculoskeletal system communicates with the central nervous system, thus increasing stability and improving the athlete's ability. Let's look at balance, speed, and flexibility in tae kwon do. Remember that these concepts very easily relate to other sports and therefore can be used by most if not all of your clients. The most popular technique associated with tae kwon do may be the "side kick." This kick has a thrust-type force and requires the athlete to stand on 1 foot, balance and coordinate the torso, focus and direct the foot, and use the hip extensors and gluteus maximus to deliver the kick. The use of the TrA immediately improves the athlete's ability to stand on one foot and allows better control of body position. This will enhance focus and accuracy when the athlete searches for his or her target. The 1-foot standing exercise with the short foot engaged and the client executing a slow lateral and hip extension motion in concert with TrA contraction will assist in the balance and accuracy portion of the kick (Figures 10 and 11). The quadruped assists in balance and *g*-max facilitation. The side thrust will help the athlete to control the torso, and the abdominal activation exercises will increase torso power. I have experienced that the faster I can activate the TrA, the

Figure 10. Side-kick plyometric (starting position).

Figure 11. Side-kick plyometric (ending position).

quicker I can kick. My kick becomes more accurate, and I have reduced the risk of injury. Augmenting exercises can also be added to this warm-up and your program to further assist in improving performance.

Conclusion

Those who suffer from chronic lower-back pain may find themselves avoiding many activities and therefore becoming less and less active. A better understanding of how low back pain is developed may encourage people to increase activity levels. By performing the core stabilization program, activity levels will increase, more balance will be gained within the lower core, and the ability to participate in desired activities may increase. ▲

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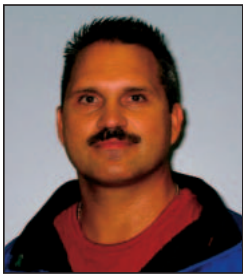

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