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Core Training

Features

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Trampoline Training: Bounce Your Way to a Rock Hard Core

When you mention the word trampoline, most people recall fond childhood memories of playing outside bouncing into the air as if they are defying gravity. Yet few people are aware of not only the health benefits of a trampoline but the tremendous core training benefits. Moreover, they do not know that many gyms and personal training studios now have mini indoor versions of trampolines called rebounders that elicit the same benefits. By bouncing on a trampoline, you are harnessing the force of gravity to strengthen every cell in your body.

Your core muscles include all muscles from your abdominal, lower lumbar, and pelvic regions. They are responsible for supporting your spine and providing you balance and stability. Traditional core training involves movements like sit ups, crunches, bridges, and planks. Yet many athletes including many gymnasts have been able to develop incredibly powerful core muscles without any of these exercises. This is due to the tremendous amount of core strength required to stabilize in their sport. And the trampoline is a perfect example of a sport that requires and develops tremendous core strength.

When you bounce off a trampoline, you end up suspended in air and then land with twice the force of gravity, which challenges your body to grow stronger (1). You constantly use your abdominal muscles with rebounder exercises to stabilize, maintain balance and postural control, and control the height of your jump. Repeatedly bouncing up and down on trampolines develops proficiency for bracing the torso with intra-abdominal pressure and improves your core muscular endurance by maintaining an isometric contraction of the abdominals (1).

Trampoline training forces your body to use your core muscles as well as proprioceptors in order to balance. Proprioceptors are specialized receptors that are located in the muscles, joints, tendons/ligaments, and the inner ear that provide information that enables your body to know where it is located in space and if necessary adjust posture or movement in order to maintain balance (1). Proprioceptor training will work your core muscles as well as the rest of your musculature, joints, etc., thus improving your overall strength and balance. When you jump on a trampoline, every muscle in your body works simultaneously to adjust the body's position to its constantly changing environment.

There are many exercises you can do to train your core on a rebounder. Here are a couple examples:

Sprint in Place

Stand in the middle of the trampoline and drive your knee up to your chest while simultaneously swinging up your opposite arm. Work at maximal output for 30 seconds to a minute.

Double Knee Ups

Stand in the middle of the trampoline and jump in the air as high as possible driving both knees to your chest. Land and immediately repeat. The goal is to jump as high as possible

Side to Side Jumps

On either one or both legs, bounce from one side of the trampoline to the other.

Planks on Trampoline

Put your feet on the ground and your fists and elbows on the trampoline in plank position underneath your chest. Prop yourself up like a table or bridge using your toes and elbows. Use your gluteals and abdominals to stabilize.

Jump Twists

Use your core to twist your hips and keep your feet together while bouncing up and down.

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Kyle Brown is a health and fitness expert whose portfolio includes everything from leading workshops for Fortune 500 companies and publishing nutrition articles in top ranked fitness journals, to training celebrity clientele—from pro athletes to CEOs to multiplatinum recording artists. Kyle's unique approach to health and fitness emphasizes nutrition and supplementation as the foundation for optimal wellness. After playing water polo for Indiana University, as well as in London, Kyle became involved in bodybuilding and fitness for sport specific training. Kyle is the creator and Chief Operating Officer for FIT 365—Complete Nutritional Shake (www.fit365.com).

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Using Functional Tests to Identify Core Weakness

The incidence of low back pain (LBP) has been reported to affect up to 80% of the US population (3). The pain associated with a low back injury can be disabling, affecting one's functional abilities. However, the good news is the majority of individuals who experience low back pain will improve on their own within approximately six to eight weeks whether or not they seek treatment.

For the athlete suffering with LBP, missing practice or competition for six to eight weeks (or longer) can significantly impact both the individual's and the team's success. To reduce the risk of experiencing a sport related low back injury, sports medicine professionals advocate functionally testing athletes in the preseason in order to identify core dysfunction (2, 4 – 6). It is possible to identify muscular weakness or dysfunctional movement patterns that, if not corrected, may contribute to a low back injury. The purpose of this article is to present a series of functional tests for the core.

Figure 1. Lunge demonstrating poor biomechanics.

The Lunge and the Squat

Having an athlete perform a functional movement such as a lunge or a squat may reveal core muscular weakness, poor functional movement patterns, or both. During a lunge, the athlete with core weakness may demonstrate torso side bending, hip (femoral) adduction and internal rotation, and knee valgus (knee crossing midline) (figure 1). Weakness of the gluteus maximus and medius muscles may be the main contributing factor to an athlete's inability to control his or her lower extremity position during the lunge.

During the squat, position yourself to observe the movement from both the front and from the side. From the front, watch for symmetry of movement as the body is lowered. Athletes with core weakness may demonstrate dysfunctional movement patterns similar to those observed during the lunge. When viewing from the side, observe the position of the spine in relation to the pelvis. Is a neutral spine position maintained (figure 2) or does it appear that squat is performed with an excessive swayback or a rounding of the lower back? Do the hips move posteriorly when descending into the squat or is the squat performed with excessive knee flexion? An inability to maintain a neutral spine (proper posture) or the utilization of a quadriceps dominant squatting technique may be signs of poor hip or lumbar musculature strength.

Muscular Endurance Tests

Poor endurance capacity of the torso muscles is also believed to contribute to the onset of low back pain (1). Several core endurance tests have been described including the two presented here: the back extensor test and the lateral musculature test (1).

The back extensor endurance test is performed with the torso unsupported as shown (figure 3). A second person is needed to use their body weight to stabilize the lower extremities. Assume the prone position on the table,

Figure 2. Side view of the squat.

Figure 3. Back extensor endurance test

Figure 4. Lateral musculature endurance test

timing how long the position can be held once the arms are folded across the chest. When no longer able to maintain this posture, terminate the test. Poor endurance of the torso extensor muscles will limit how long the position can be maintained.

To conduct the lateral musculature test, assume the side plank pose (figure 4). Maintaining form is crucial here, watch for compensatory or "cheating" strategies. Watch first for the inability to assume the testing position. Many athletes are just physically unable to assume the position demonstrating gross weakness of the lateral core muscles. Others, once the position has been assumed, are unable to maintain a straight (neutral spine) posture. You will quickly see hips drifting toward the table top or observe torso rotation forward or backward.

Conclusion

These four tests presented here may help identify gross core weakness. McGill has described a specific testing strategy for the core endurance tests (1). It is outside the scope of this article to present his entire testing strategy, however I recommend reviewing his text Low Back Disorders (Human Kinetics). Addressing core weakness in the preseason may help reduce an athlete's risk of sustaining a back injury during the season.

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Does Muscle Activation Differ Between Male and Female Soccer Players during Side-Step Cutting Maneuvers?

Female soccer players appear to be at a greater risk of anterior cruciate ligament injuries than their male counter parts. One hypothesis for this occurrence suggests that there is a difference between the lower extremity muscle activation patterns of male and female athletes. In order to test this hypothesis researchers from the University of North Carolina Chapel Hill compared the muscle activation patterns of male and female Division I soccer players during 2 side-step cutting maneuvers. Twenty male (age = 19.4 ± 1.4 years; height = 176.5 ± 5.5 cm; weight = 74.6 ± 6.0 kg) and twenty female (age = 19.8 ± 1.1 years; height = 165.7 ± 4.3 cm; weight = 62.2 ± 7.2 kg) soccer players performed a running approach side-step cut and a box-jump side-step cut. During each cutting task the electromyographic activity of the rectus femoris, vastus lateralis, medial hamstrings, lateral hamstrings, gluteus medius and gluteus maximus were recorded. The results of the study revealed that the female soccer players exhibited greater vastus lateralis activity and quadriceps to hamstrings co-activation ratios during the preparatory and loading phases of the cutting activities. The increase in quadriceps to hamstrings co-activation ratio suggests that female soccer players did not increase their hamstrings activation to compensate for the increased quadriceps activation seen during the cutting task. This occurrence may explain why a greater number of non-contact anterior cruciate ligament injuries occur in female soccer athletes when compared to their male counterparts. While this data is interesting it is important to note that much more research is needed in order to fully understand why female soccer athlete are at greater risk of anterior cruciate ligament injuries.

Hanson, AM, Padua, DA, Troy Blackburn, J, Prentice, WE, and Hirth, CJ. Muscle activation during side-step cutting maneuvers in male and female soccer athletes. *J Athl Train* 43:133 – 143. 2008.

Whole Body Vibration Training Improves Proprioception and Balance in Athletes with Reconstructed Anterior Cruciate Ligaments.

Recently researchers from The School of Rehabilitation at the University of Tehran compared the effects of a whole body vibration rehabilitation program with a conventional rehabilitation intervention to determine the effects of each method on proprioception and postural stability in athletes who recently had anterior cruciate ligament surgery. Twenty athletes were randomly assigned to the vibration or conventional rehabilitation treatment groups. All athletes received 12 treatment sessions regardless of treatment program. Prior to and after the treatment intervention time period the athlete's bilateral dynamic postural stability was assessed with the Biodex Stability System. Proprioception was also assessed with the Biodex dynamometer. Results of the study revealed that the application of a vibration based treatment program resulted in significantly greater improvements in postural stability and proprioception. Based upon these results it appears that the inclusion of whole body vibration treatments may be useful in rehabilitating athlete from anterior cruciate ligament injury. However, more research is needed in order to fully understand the effects of this novel treatment strategy.

Moezy, A, Olyaei, G, Hadian, M, Razi. M, and Faghihzadeh, S. A comparative study of whole body vibration training and conventional training on knee proprioception and postural stability after anterior cruciate ligament reconstruction. *Br J Sports Med* 42:373 – 378. 2008.

Does Whole Body Vibration Improve Balance and Gait in Individuals Suffering From Parkinson's Disease?

Rehabilitative therapy is widely accepted as a method for managing the effects of Parkison's disease. Recently the effects of whole body vibration and conventional therapeutic modalities were compared in order to determine the effects of each method on balance and gait. Twenty seven patients with Parkinson's disease with dopa-resistant imbalance on stable dopamine replacement medications were randomized into the vibration (n = 13) or conventional (n = 14) treatment conditions.

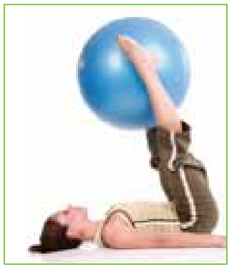
Each subject received 30 treatment sessions consisting of two 15 minute session five days a week for three weeks. Vibration therapy consisted of standing on a whole body vibrating device which oscillated at 25 Hz with an amplitude of 7 – 14 mm. The conventional treatment group performed traditional balance training such as tilt board exercises. The primary measure of balance was the Tinetti Balance Scale Score, while secondary clinical ratings included stand-walk-sit tests, walking velocity, Unified Parkinson's Disease Rating Scale score, and dynamic posturography. The tinetti score improved in both the vibration and conventional therapeutic modalities groups. The quantitative dynamic posturograph only improved in the whole body vibration treatment group. Based upon the results of this study it was suggested that whole body vibration treatment methods were equally as effective as conventional balance training methods, thus offering the Parkinson's patient an alternative method for improving balance and gate performance.

Ebersbach, G, Edler, D, Kaufhold, O, and Wissel, J. Whole body vibration versus conventional physiotherapy to improve balance and gait in Parkinson's disease. *Arch Phys Med Rehabil* 89:399 – 403. 2008.

Resting Energy Expenditure and Fat Free Mass Are Conserved With Resistance Training Following Weight Loss

Typically when an individual losses body weight, lean body mass is typically decreased and there is a concomitant decrease in resting energy expenditure. These effects appear to be magnified when aerobic exercise is the predominant mode of training used in the weight loss intervention. One plausible exercise solution for preventing the loss of lean body mass and a reduction in resting energy expenditure would be the use of resistance training. This phenomenon was explored with a longitudinal randomize weight loss clinical intervention in which subjects were randomly divided into an aerobic (AT), resistance (RT) or no exercise (NT) Group. During the training interventions (AT or RT) subjects exercised 3 days per week for 5 weeks and consumed a diet of 800 kcal per day with the intent of reducing BMI to < 25. The NT group just consumed 800 Kcal per day. The RT intervention included a variety of exercises which were performed with progressively increasing intensities and volumes. The AT treatment began with 20 minutes of continuous exercise and progressed to 40 minutes at the end of the 5 week time period. All three groups lost weight in response to the interventions (AT = 13.0 kg; RT = 11.6 kg; NT = 12.5 kg). The results of the study demonstrated that the AT and NT groups lost lean body mass and had a decrease in resting energy expenditure. Conversely, the RT group maintained lean body mass and resting energy expenditure. Based upon this data it was suggested that resistance training has an important place in weight loss interventions.

Hunter, GR, Byrne, NM, Sirikul, B, Fernandez, JR, Zuckerman, PA, Darnell, BE, and Gower, BA. Resistance Training Conserves Fat-free Mass and Resting Energy Expenditure Following Weight Loss. *Obesity* (Silver Spring, Md) 16(5): 1045 – 51. 2008. ■



Core Training Using a Domed Device

Chat Williams, MS, CSCS,*D, NSCA-CPT,*D

Over the years there have been multiple pieces of unstable equipment implemented into training programs to challenge balance, proprioception, coordination, and the core musculature. One popular piece of equipment is the BOSU® (DW Fitness LLC, NJ) (1) Balance Trainer (Both Sides Up) dome, which has been used for athletic development, small group training, boot camps, and one-on-one personal training sessions. Incorporating the domed device into a current training regimen can be another modality for you to create fun, challenging, and rewarding programs for yourself.

Defining the Core

Developing and maintaining a strong core is essential for all individuals when performing activities of daily living and sport specific movements. A strong core can improve muscular coordination during movements, maintain posture and balance, increase core function in the transverse plane (decelerates hips and shoulders), frontal plane (decelerates the drop of the pelvis when the foot hits the ground then accelerates the trunk helping the leg swing through), sagital plane (decelerates lumbar extension during anterior motion of the pelvis when the foot hits the ground), and most importantly provides stability controlling these movements through the core to the upper and lower parts of the body.

The core consists of not only the abdominal muscles, but includes the hips and the back as well. The following is a more descriptive list of muscles involved in the core region:

Abdominals

Internal and external obliques, transverse abdominus, and rectus abdominus.

Back

Paraspinals, trapezius, psoas major, multifidus, erector spinae, quadratus lumborum, iliocostalis loborum and thoracis, latissimus dorsi and serratus anterior.

Hips

Obturator internus and externus, quadratus femoris, periformis, psoas, rectus femoris, sartorius, tensor facia latae, pectenius, adductor brevis, magnus, and longus, gemellus superior and inferior, pectenius, gluteus maximus, medius, and minimus, semitendinosus, semimembranosus, and biceps femorus.

Benefits of Training the Core Muscles

Research has shown that performing movements on unstable surfaces can enhance stabilization, balance, coordination, increase muscular recruitment of the core, and may aid in preventing injuries (2). Many muscles of the upper and lower body attach in the core region at the pelvis and spine. Training on an unstable surface may improve muscular coordination and increase power efficiency during movements. Balance is the ability to maintain a fixed base of support over a period of time and training on an unstable surface can enhance proprioception, which is one's own awareness of body movement and body positioning (3). This plays an important role for the athlete maintaining a position on the field. Reducing the chance of injury may be the most important variable when training. When muscles from the pelvic region are not recruited properly due to tightness or lack of stability in the hips other areas will overcompensate and may lead to an injury (4). Having a strong and stable core can decrease the chance of injury.

Program Design

When incorporating the domed device into a training program proper progressions should be followed so that the less challenging movements are mastered first. All movements should be performed on a stable surface before trying them on an un-stable surface.

Be able to perform bodyweight movements on the domed devices before adding external resistance (medicine ball, dumbbell, resistance tubing).

Complete the movements successfully on two-feet (bilateral) before attempting them on one foot (unilateral).

Finally, once exercises have been mastered statically, more dynamic exercises can be implemented to create more of a challenge. This would include jumps and hops on the domed device.

about the AUTHOR

Chat Williams is the owner of Oklahoma Strength and Conditioning Productions, a company offering sports performance for youth, personal training, metabolic testing, and educational conferences. Williams holds positions as the wellness coordinator for Norman Regional Health System, the NSCA State Director Committee Chair, and sits on the NSCA's personal trainer SIG executive council. Previously, Williams was Midwest regional coordinator and state director of Oklahoma, where he earned recognition in 2004 as the state director of the year. Williams is the author of instructional DVDs focused on a variety of topics related to the fitness field.

Table 1

Full Body Routine

Incorporating domed device into a traditional program.

Bench Press
Body Weight Squats with Diagonal Chop
Machine Seated Row
Transverse Plane Lunge/Dumbbell Toe Touch
Seated Medicine Ball Tosses on Dome
Seated Leg Curl
Machine Overhead Press
Medicine Ball Slam on Knees
Dumbbell Bicep Curls
3 Point Push-Up

Exercises performed on the domed device can be incorporated into a current training program to increase the intensity of a specific exercise or a group of domed device exercises can be put together to focus on training the core. Exercises on the domed device should resemble other forms of training when deciding volume (sets x repetitions), intensity, duration, and rest times. Once a certain fitness level is achieved, progressively increase the variable of the goals that have been set. See Table 1 for an example of a full body routine that incorporates traditional training with exercises performed on a domed device.

Exercises

The following exercises are just a few examples that can be incorporated into a training program that will challenge the core. The examples include multiple variations of core training with exercises being performed seated, on the knees, standing, and using the upper body.

Body Weight Squat with Diagonal Chop (Figure 1 and 2)

Standing on the domed device, lower the body under control. Keep the core tight and a neutral spine.

Knee flexion should be approximately 90 degrees or where the thigh (upper leg) is parallel to the floor. This will depend on individual flexibility. Drive through the feet and return to the standing position.

The medicine ball can be taken from the shoulder to the opposite knee (creating a chopping motion) when ascending and descending during the squat.

To increase difficulty, the chopping motion can be taken from the shoulder to the opposite ankle.

Transverse Plane Lunge/Medball Toe Touch onto Domed Device (Figure 3)

Start with the feet shoulder width apart, initiate movement by opening up the hips creating rotation in the trunk/core region. The lead leg/ foot should finish at approximately 135 degrees on the domed device; toes of the trail leg might turn in slightly. This will depend on knee mobility, flexibility of the hips and the core, and the overall strength of the lower body.

During the lunge while opening up the hips, reach towards the lead foot with the medball, creating more of a challenge for the hips and glutes.

The ability to decelerate the movement (lead leg) in the transverse plane and return to a starting position will also create some challenges.

3 Point Push-Up (Figure 4 and 5)

Position body in the prone position with the left hand on one dome and the right hand on a medicine ball. Maintain the body in a neutral position throughout the entire movement.

Perform a push-up, walk over (with hands) so that both hands are on the medicine ball, perform another push-up, finally place the right hand on the other dome, keeping left hand on the medicine ball and perform a push-up. Repeat back the other direction.

Medicine Ball Slam on Knees (Dome) (Figure 6)

Begin with both knees on the dome facing a partner, and in one motion (with medicine ball) extend the arms over the head eccentrically loading the core and slam the ball explosively to the ground (to your partner).

To increase the intensity, place one knee in the center of the dome and perform the same movement.

Seated Medicine Ball Tosses on Dome (Partner) (Figure 7 & 8)

Start in the seated position on the dome. Feet can be placed on the floor, one foot up, or both feet in the air. Placing both feet in the air will challenge the core/balance and increase the intensity of the exercise.

Have a partner toss a medicine ball back and forth to you while walking around. Intensity can be increased by speeding up the tosses, not having a planned pattern, and tossing the ball a little out of range.

180º Jumps/Transverse Toss (Partner) (Figure 9 & 10)

Receive the ball on the dome with your side facing your partner. Have your partner throw the medicine ball to one side.

Catch the ball, decelerating the momentum; simultaneously with arms extended follow through throwing the ball back to your partner while performing a 180 degree jump (land with soft knees and stick) and repeat.

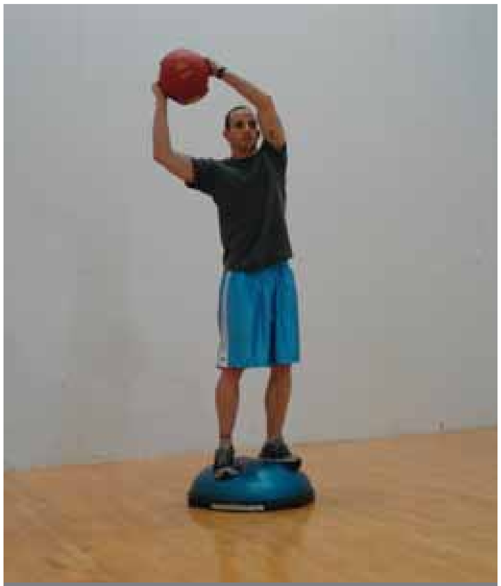


Figure 1. Bodyweight squat with diagonal chop (start)

Figure 2. Bodyweight squat with diagonal chop (finish)

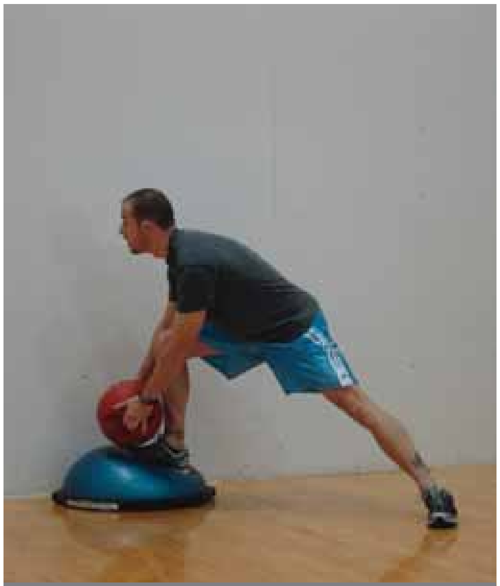


Figure 3. Transverse plane lunge/ medball toe touch

Figure 4. Three point push-up (start)

Figure 5. Three point push-up (finish)

Figure 6. Medicine ball slam on knees

Figure 7. Seated medicine ball toss (foot touching)

Figure 8. Seated medicine ball toss (both feet up)

Figure 9. 180° jumps/transverse toss (start)

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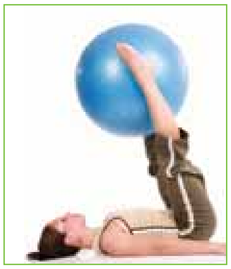
Figure 10. 180° jumps/transverse toss (finish)



The Missing Link: Integrated Core Training

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In the past decade or so, core training programs have become increasingly popular, based on the belief that core strength and endurance are important for maintenance of low back health, static and dynamic trunk (core) stability, injury prevention (especially the back and lower extremities), and energy production and transfer from the trunk/pelvis to the extremities in basic tasks and sport-specific movements. Despite the prevalence of core training, there is lack of universal agreement on what constitutes the core and in the definition of core stability.

In general, the core includes the lumbopelvic region: hips, abdomen and low back. Since there is no universal definition of what muscles make up the core, and that the core must function as part of the kinetic chain, we have broadly defined core by region and have not identified specific core muscles. We believe identification of specific isolated muscles is a moot point when discussing the application of integrated core exercises. We leave the determination of specific core musculature up to your interpretation of the literature and your practical experience.

Core stability is defined in many ways. Due to its practical emphasis, we use the definition of core provided by Dr. Ben Kibler and colleagues at the Lexington Clinic Sports Medicine Center in Lexington, Kentucky: "Core stability is defined as the ability to control the position and motion of the trunk over the pelvis to allow optimum production, transfer and control of force and motion to the terminal segment in integrated athletic activities" (5).

The sports medicine literature identifies two primary purposes for strengthening the core musculature. Core strengthening for stabilization and injury prevention focuses on improving muscle endurance, in contrast core training for strength and power is used to enhance the transfer of energy from the core to the extremities. When it comes to joint stability, muscles do not need to produce a lot of force to stabilize the core, but they need to do it all of the time. In other words, endurance is more important than strength (1) in relation to injury prevention.

Core strengthening for force production and transfer require higher degrees of stability due to larger forces generated by the arms and legs. For example, the legs and trunk contribute 78% of the energy generated during a boxing punch (7), while the hips and trunk generate 51% of the energy during a tennis stroke (4). Exercise and program selection for endurance versus strength/power training differ considerably, as discussed in the following two sections.

Core Programs

We have seen numerous isolated core exercise programs, but we have not found the same degree of focus in exercise programs that address integrated core exercises as part of the kinetic chain. The purpose of core training for performance is to provide a stable base for extremity force production and transfer, but the base must remain stable (neutral spine position) during the entire exercise. Bliss & Teeple recommend the implementation of dynamic, multiplanar, balance, proprioception, and power exercises (2). For example, you may be able to maintain neutral spine during the exercises presented in Table 1, but can you maintain a neutral spine during a high speed rotational exercise like the rotational toss, or more sports specifically, during an overhead throw? We must bridge the gap between isolated core and sports specific exercises. Utilizing integrated stabilization exercises that more closely match the sports specific demands of the core and facilitate energy transfer (Table 2) will accomplish this goal.

The principle of progressive overload can be applied by decreasing the base of support, increasing the distance of the resistance from the body's center, or controlling

Table 1

Sample Core Stabilization Program

BW = Body Weight

RM = Reception Maximum

Exercise	Load	Reps	Sets	Rest Period	Times/ Week
Neutral spine- supine, quadruped, and standing	BW	15 – 20	2	90 sec	2
Quadruped/ Bird Dog	BW	15 – 20	2	90 sec	2
Bridging on Back	BW	15 – 20	2	90 sec	2
Side/lateral Bridge	BW	15 – 20	2	90 sec	2
Single Leg Balance	BW	12 – 15	2	90 sec	2
Squat- Overhead Barbell	12 – 15 RM	12 – 15	3	2 min	3
Squat- Overhead Unilateral Dumbbell	12 – 15 RM	12 – 15	3	2 min	3

body movements outside the base of support. Let us take the squat exercise as an example. The squat exercise requires a certain degree of core stability to move a maximal load safely. We can increase the degree of stabilization needed by providing a load further away from the body's center. This can be accomplished by holding a dowel with arms extended overhead (figure 1), a weighted barbell overhead, or dumbbells overhead. Dumbbells require more stabilization than a barbell because the upper extremities are free to move independently.

Another way to increase the stabilization required by core muscles is to utilize unilateral training. You can significantly increase the rotational stability needed by providing a unilateral resistance for many of the traditional exercises. Off-setting the resistance to one side of your body significantly increases the rotational stability demands. Although pushing or pulling exercises from a standing position tend to be somewhat muscle group specific, they still require high degrees of static core and lower extremity stabilization.

Dynamic exercises like the squat (Figure 2) and alternating lunge (Figure 3) increase stability requirements because more force is produced by the legs to cause the motion. Performing a high speed, multi-joint exercises (e.g., vertical medicine ball toss (Figure 4), power clean and power snatch) requires additional levels of core stability because of the speed of the motions. Unilateral dumbbell training further adds to the required stabilization to maintain NS for each exercise.

Although core muscle endurance is very important in injury prevention and maintaining performance over time, you can see how the integrated core exercises require more strength to stabilize against greater upper and lower extremity force development and transfer. We hope that these examples provide a base for professionals to provide exercises that involve the core as a part of the kinetic chain in their exercise programs.

Program Design

Every consideration that goes into designing an effective exercise program for the rest of your body should go into designing a program for the core: exercise selection, load, volume (reps and sets), rest periods, frequency, and progression. In the last section, we offered suggestions on effective exercises for training the two functions of the core. In this section, we discuss the components of exercise program design for the core and how to integrate them into a larger exercise regime.

There is an inverse relation between load and repetitions: the higher the load, the lower the number of repetitions that can be performed with that load. With this fact in mind, we prescribe a load based on a repetition range: one to six repetitions to increase strength, six to 12 repetitions to increase mass, and 12 or more repetitions to increase muscular endurance (6). After establishing a goal for a particular exercise (strength, mass, endurance), choose a load that you can perform a number of repetitions with good form in that range—no less, and no more. There is also an inverse relation between repetitions and sets: the lower the number of repetitions, the higher the number of sets that need to be performed to get the same volume.

The fact that core stability requires minimal strength (1) suggests that core stability exercises should be performed with a low load, a high number of repetitions (12+), and a low number of sets (two to three). Since the generation and transfer of energy may require high loads, recommendations for training this function of the core is not congruent with training for core stability. Higher loads and a lower number of repetitions are necessary. Some activities (e.g., baseball pitching) may require the generation/ transfer of energy repeatedly. Training for these activities may require a high (4+) number of sets.

An often overlooked aspect of program design is the amount of rest between sets. The training goal of the exercise will determine the optimal rest periods between sets. Dr. Jeffrey Willardson of Eastern Illinois University found that the optimal rest period is three minutes for power, one to five minutes for strength, 30 – 60 seconds for mass, and 30 seconds for endurance in different muscles and three minutes for the same muscle (8).

Exercise	Load	Reps	Sets	Rest Period	Times/ Week
Romanian Deadlift					
Double leg	3 – 6 RM	3 – 6	4	90 sec	2
Single leg dumbbell	9 – 12 RM	9 – 12	2	90 sec	2
Unilateral Dumbbell Training					
Alternating Lunges	9 – 12 RM	9 – 12	2	1 min	2
Standing					
Push	6 – 9 RM	6 – 9	3	90 sec	3
Pull	6 – 9 RM	6 – 9	3	90 sec	3
Dumbbell Clean	3 – 6 RM	3 – 6	4	2 min	2
Dumbbell Snatch	3 – 6 RM	3 – 6	4	2 min	2
Medicine Ball Exercises					
Vertical Toss	3 kg	9 – 12	3	1 min	2
Rotational Toss	3 kg	9 – 12	3	1 min	2

Table 2

Sample Energy Transfer Program

RM = Reception Maximum

Another myth that we often encounter is that the core muscles, particularly the abdominals, can and should be trained every day. The optimal training of muscle is two to three times per week (6), and there is no anatomical or physiological evidence to suggest that training the core should be any different. With these components in mind, we offer sample programs in Table 1 and Table 2 for training core stabilization and energy transfer, respectively.

Once the core has adapted to a particular program, a more difficult program is needed to elicit further improvements. People often increase the load as a way to satisfy this principle of progressive overload, but the program can be also be made more difficult by increasing the volume, decreasing the rest periods, or using a more challenging exercise. While several of these variables could be increased simultaneously, we recommend increasing only one at a time to safely induce an overload and prevent overtraining. For example, if the load of the exercise is increased, the volume should remain constant or even decreased until the core can handle the new load.

Finally, training of the core does not occur in isolation. It is part of a larger exercise program, and may have a different priority during different phases of the longer term plan. At times, the core may be the focus of training. At others, direct core exercises may be a minor part of the overall program. The bottom line, the core need not and should not be the focus of every training session throughout the year, but it should not be programmed in as an afterthought either.

Maximizing injury prevention and athletic performance requires appropriately training each function of the core. Following basic strength training principles, matching program variables (load, sets, repetitions, and rest intervals) to the demands of each function and including exercises that incorporate the core as part of the kinetic chain will accomplish this goal.

Figure 1. Overhead squat with dowel

Figure 2. Unilateral dumbbell squat

Figure 3. Unilateral alternating dumbbell lunge

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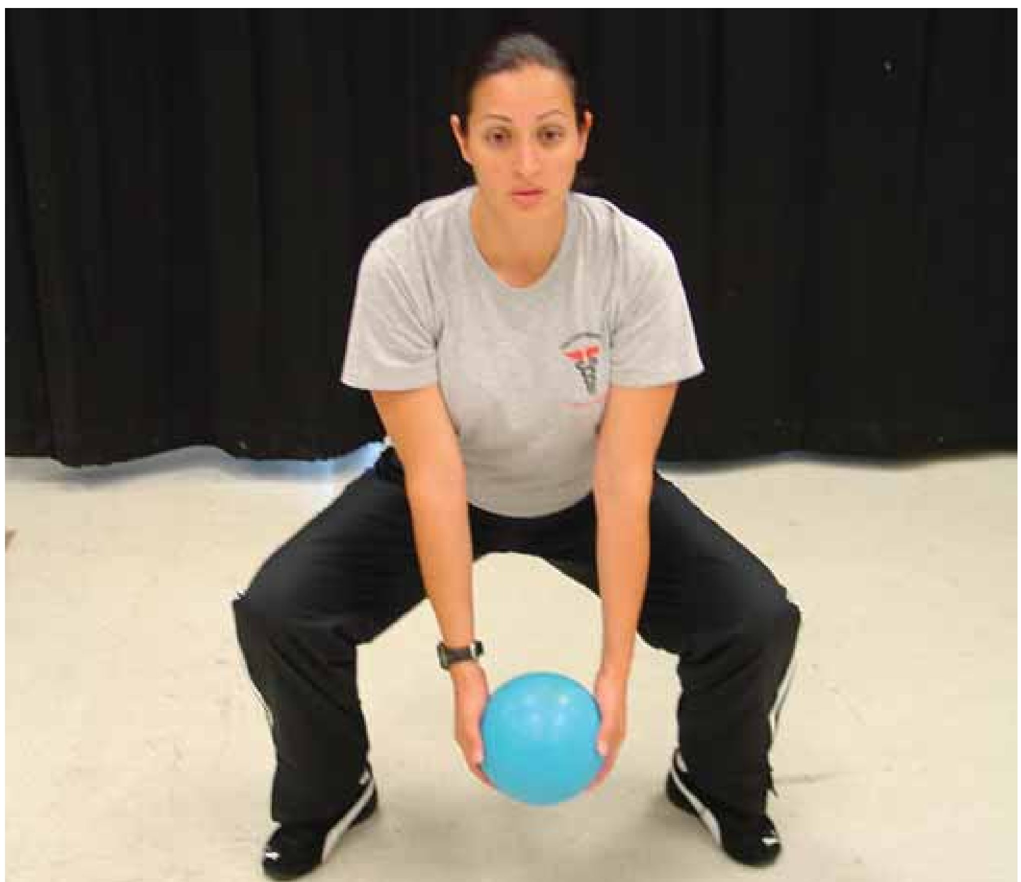

Figure 4. Vertical medicine ball toss

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Energy Bars: Are they worth the energy?

With all the energy bars on the market it may be difficult to decide which is right for you or if you even need one? How do you know when to use an energy bar? Are energy bars better for you than real food or are they just candy bars with a nutritious name? Let us start by considering the scientific literature surrounding fuel and activity.

After 60 minutes of continuous exercise your body has most likely used all of the glucose and glycogen stored in the muscles for energy and it is at this point that carbohydrates need to be ingested in order to refuel the muscles (2). Carbohydrates can be found in sports drinks (like Gatorade®), gels (like Gu®), energy bars (like Powerbar®), or real food. After an intense training session, protein and carbohydrates are needed to replenish lost glycogen stores and help the muscles rebuild and repair (2). Post-workout you can refuel with a protein/carbohydrate drink (like Accelerade®), a protein/carb bar (like Powerbar® Recovery), or real food (like a turkey sandwich).

So, which is better for you to choose a bar or a sandwich? Several studies have shown that real food is a better choice for fuel during exercise and recovery (1, 3) There is no nutritional advantage of an energy bar over real food (1, 3). If you are going on a long bike ride, for example, you would get the same necessary carbohydrate fuel from a bagel, a banana, or an energy bar. You will likely get more nutrients, found in its natural state, from real food.

Many athletes also think that a protein shake will provide them with the extra protein they need for recovery after a strenuous workout. In truth you can get the protein you need from eating foods such as chicken breast, turkey burger, or tofu stir-fry. While bars certainly provide carbohydrates and/or protein and some contain a "vitamin pill", they do not offer the full range of nutrients that come from eating real food. In addition bars, often contain more fat and sugar than you would get from eating a piece of fruit, bagel or a chicken breast. Also, gram for gram, real food is cheaper.

One real benefit of bars is that they are convenient and portable. There are times, such as during a very long training run, where it may not be feasible to eat real food and bringing a bar is the best option. In these cases, you want to choose a bar that is high in carbohydrates, low in fats and not too high in fiber. But, be careful. In order to taste good, many bars contain large amounts of saturated fats and sugars and are often likened to a candy bar with a few vitamins added. A popular oil used in manufacturing energy bars is palm kernel oil because it stays solid at room temperature, which means the coating found on many bars won't smear all over your hands. That may sound good. However, the problem is that palm kernel oil is twice as saturated as lard—and likely to elevate your cholesterol and clog your arteries.

Make sure you read the labels and are getting the kind of bar you need. For a bar to be used during exercise it should contain 60 % of carbohydrate (2) and not contain too much fiber as this may cause GI distress while exercising. For a bar to be used for recovery, look for one that has a 3:1 ratio of carbohydrate to protein for maximum glycogen re-synthesis and to increase muscle protein synthesis (2). It is okay to choose a bar with more fiber during recovery and make sure you drink plenty of water to help with the digestion of both the fiber and protein. Always keep an eye out for saturated fats and total calories. Since some athletes may also be watching their caloric intake, it is a good idea to know how many calories you are consuming in bars and in sports drinks combined—it may be more than you think and it may be more than you need.

Bottom Line—while energy bars are convenient and portable, they do not provide any more energy or nutrition than real food. If at all possible, try to eat real food during and after a workout to give your muscles the energy and nutrients they need for exercise and for re-fueling.

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Product	Energy (kcal)	Carbohydrate	Fat	Protein	Fiber
Powerbar	225	75%	8%	18%	3 g
Cliff Bar (peanut butter)	250	72%	14%	16%	4 g
Tiger Milk Bar	130	74%	17%	12%	1 g
Kellog Nutri-Grain Bar	140	77%	19%	6%	1 g
Nature Valley Granola Bar	180	64%	30%	11%	2 g
Milky Way Bar	270	61%	33%	3%	1 g
Snickers Bar	280	50%	45%	6%	1 g
Bagel (4 ½ inch)	275	77%	.05%	15%	2 g
Apple (medium)	81	100%	n/a	1%	4 g
Banana (medium)	108	100%	n/a	2%	3 g

Table 1

Nutritional Breakdown of Composition of Various Energy Bars and Other Foods

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No Excuses

about the AUTHOR

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No Excuses. It is a common slogan in athletic environments, often seen on the back of t-shirts and sweatshirts or on the walls of weight rooms.

No Excuses. These are two simple yet powerful words. The slogan exhorts athletes to maintain focus and to put in the physical and mental work needed to perform at their best, there are no excuse for doing something that could prove to be detrimental to performance or avoiding the work that needs to be put in. Yet think about how often we make excuses that impact our training and preparation. Maybe it is an excuse not to train today or to slack off in the weight room. Maybe it is an excuse you make in order to justify that second dessert. Or maybe it is you blaming the weather, or your negative attitude, for your lackluster performance on the field of play. There is any number of things you could blame for why you were not prepared to perform your best.

No excuses. As with many of the mental skills and concepts we have discussed, the notion of making no excuses, of holding yourself accountable for your behavior is easy to understand but much more difficult to implement. While the words are powerful, it is the action behind the words that speaks volumes. Do you back up these words with action?

In retrospect, an athlete can readily identify when excuses have been used as a crutch, but by then it is too late, as the workout or performance has already been compromised. Think back on the past few weeks of your training and identify the situations where you may have allowed excuses to impact your behavior. Were there moments where you thought, in retrospect, "I could have given more," "I should have gotten up early to train even though it was snowing" or "I wish I could have that workout to do-over?" My guess is most of you can identify at least one situation where you came up with an excuse to not work as hard as you could have, to not train on a given day, or to explain a less than stellar training behavior. Awareness of instances where you make excuses is important as it is through this awareness that you can attempt to change future behavior.

Besides opening your eyes to the excuses you make, an additional challenge is to figure out how to be pro-active as opposed to reactive. So, instead of identifying excuses after the fact and "kicking yourself" for it, let us work to nip them before they impact behavior by identifying your tendencies and patterns. It is a tough challenge, but here is an example that can help us walk through one way to do this.

Colin, a local triathlete, does not miss a day of training. He has been training hard for years and tends to do decent in races but never quite achieves his performance goals. When critically analyzing his preparation and training, it becomes evident that the truly "hard workout days" present a barrier for him. On these hard training days, he has a tendency to back off a bit. He always has a reason for backing off—one day it is the wind in his face on the bike, another it is the slight twinge he felt in his quad earlier that day, another it is thinking about the work that needs to be done back at the office. But the reasons differ every time so they seem separate, are these excuses, perhaps? For Colin, he tends to come up with seemingly valid reasons not to get after it on his hard training days. But in analyzing his preparation, it is interesting how these things only pop up on the hard days. His training is just where it should be on the lighter days. In looking back and analyzing his performance, Colin recognizes that he is making excuses, and just as importantly, he realizes how important those hard days are to reaching his goals. It finally clicks in his mind that there is a cause-effect relationship and those excuses are keeping him from performing at his best.

Apply this to yourself, do you have excuse tendencies? It is important to identify these tendencies as it becomes easier to than avoid them. By knowing unique situations or factors that seem to relate to coming up with excuses, you can be pro-active in avoiding them.

For some of you, it may also be valuable to dig deeper and take a look below the surface to see what might be going on. Is there a reason why you are coming up with excuses that need to be addressed head on?

Back to our example, Colin identified a tendency to have excuses on hard training days, excuses that gave him a reason to back off or scale down his effort and expectations. Is he just lazy and needs to buckle down and not succumb to excuses? When he analyzed it, Colin realized he puts immense pressure on himself to reach the time goals he set for himself on these training days, but he really does not believe he could run, swim, or cycle that fast. So, no, he is not being lazy, but rather his lack of confidence is at the forefront of the excuses. His challenge now becomes working to build his self-confidence (perhaps by focusing on different goals, recording his daily successes, and using imagery to experience success) not simply monitor excuses he makes.

Apply this to yourself, is there a common thread behind excuses you use? Whether it is lack of enjoyment, motivation issues, competing priorities, fear of failure, or some other thread, it needs to be identified to truly be tackled. ■