Core Training for Superior Sports Preparation

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Abstract

The core is at the center of most sports movements. What the core musculature is, how it is evaluated, how it is trained, and how it is applied to functional performance can sometimes be confusing to coaches. The benefits of a sound, research-based core training program is essential to all sport; therefore it must be included in coach’s education. The core musculature is separated into two systems: local (stabilization) and global (movement). Exercises can be separated into three categories: core-stability, core-strength, and functional exercises. A multi-faceted approach that addresses the three planes of movement combining medicine-ball work, body-weight circuits, controlled movements, abdominal exercises, dumbbell complexes, and Olympic lifts can provide physiological and biomechanical advantages that enhance preparation for most every sport.
Introduction

Superior sport performances are a product of a number of factors. Efficient technique, the progression of speed and maturing competitive attitude on a sound basis of all-around strength, general endurance, and general mobility are just a few of these key contributing variables. Strength and conditioning programs are specifically designed for each sport and even for different positions or events within a sport to maximize the effectiveness of such factors. One particular area of athletic preparation, core training, has become the new buzz word in strength and conditioning over the last decade; a strong core is the foundation for all athletes in all sports. There are as many approaches to developing this very fundamental quality as there are athletes, coaches, sport scientists, and physio-therapists. But despite its importance to all athletics, the implementation of core applications and/or advanced abdominal exercises into fitness and sport performance protocols occurs more rapidly than valid research is being conducted (Faries, 2007).

Core training sometimes takes a back seat to many other training variables and stimuli in coach’s education. In order to enhance the competency of coaches, it is the responsibility of practicing coach educators in the field of coach’s education to link commonalities among sport and to present these training philosophies in a manner that is research-based. This article will address NASPE standards 12 and 15, in domain 3, physical conditioning and will highlight the importance of using scientific principals in designing and implementing strength and conditioning core training protocols for coaches.

Review of Literature

It is important to first identify the anatomy involved in the region commonly referred to as the core. The “core musculature” can be defined generally as the 29 pairs of muscles that support the lumbo-pelvic hip complex in order to stabilize the spine, pelvis, and kinetic chain during functional movements (Fredericson, 2005). The primary muscles responsible for the quick, ballistic, and rotational movements are the external and internal obliques, rectus abdominis, transversus abdominis, and the erector spinae. Utilization of these muscles allows the trunk to flex, extend, and rotate (Marieb, 1992). Over the last decade strength training has
evolved to emphasize the strengthening of core muscles as a means of improving performance (Brown, 2006). But, most of the claims are anecdotal as there is limited research to support these claims (Faries, 2007). Coaches have, through convention, included some level of torso preparation in their athletes' conditioning programs because empirical data seems to have shown that training the trunk and pelvic musculature is advantageous (Hedrick, 2000). Popular training programs for the abdominal muscles often emphasize global strength gains by using the rectus abdominis muscles as prime movers. Sit ups, crunches and their derivatives with or without rotation, and leg raise exercises often form the bases of many core training programs (Norris, 1999). Exercise protocols sometimes neglect proper conditioning of the local or stabilizing system through low intensity slow movements and progress too quickly into more explosive global exercises (Faries, 2007). Hagins and associates (1999) showed that a four-week lumbar stabilization program improved the ability to perform progressively difficult lumbar stabilization exercises (Hagins et al., 1999).

While specialized training provides great benefits to many athletes, any enhancement of power can be severely restricted if general strength parameters, mobility, stability, and posture are not also addressed (Chard, 1987; Chiu, 2003; Fry, 1992; Hides, 2001). Cholewicki and associates recognized that “active control of spine stability is achieved through the regulation of force in the surrounding muscles, consequently, co-activation of agonistic and antagonist trunk muscles stiffen the lumbar spine and increase its stability” (Cholewicki, 2000, p. 1380). Stabilization training is often neglected in specialized sport preparation (Norris, 1999). If the extremity muscles are strong and the core is weak, an adequate summation of forces cannot be created to perform efficient movements (Tse, 2005). It has been proposed by Souza and associates that the spine can become unstable because of feeble trunk stabilizer muscles (Souza, 2001).

To avoid this potential problem, the development of core stability, endurance, and strength should be a primary training goal for all sports (Faries, 2007). Poor mobility, strength imbalances, overuse injuries, and a lack of general coordination can often be traced back to deficits in the mid-torso (Tse, 2005). Sport movements occur in multiple directions and as a result, athletes must possess lumbopelvic stability in all three planes of motion (Leetun, et al, 2004). Lumbopelvic instability can be both the source and the product of an injury (McGill, 2004). The core is used in sport as a rigid and stable segment to dissipate force or transfer energy (McCarrol, 1982), however it must sustain a balance of mobility to adapt to situations...
and circumvent injury (Voight & Cook, 1996, Oliveto, 2004). A majority of studies support the efficacy of training the various areas contributing to lumbopelvic stability in reducing the incidence of injury (Barr, 2005; Cusi, 2001; Hides, 2001; Tse, 2005).

Substantial core stability and endurance research has been carried out in the physiotherapy/rehabilitation discipline (Tse, 2005). The studies have centered on spine pathology and the reduction of low back pain (LBP). The incidence of LBP in athletes is not unusual and its occurrence has been well documented in a variety of sports that consist of multi-planar movement including: football, golf, gymnastics, running, soccer, tennis, and volleyball (Brody, 1987; Chard, 1987; Hutchinson, 1995; Johnson, 1999; McCarrol, 1982; Nadler, 1998; NCAA, 1999; Saal, 1988; Wadley, 1993). A good number of sports engage in rotational movement, however training programs sometimes under-train this rotational component (Hedrick, 2000). Although core strength exercises are often introduced into an athlete’s exercise sequence to avert LBP; converse to what is commonly thought, data suggests that trunk muscle endurance (not strength) is related to LBP symptom reduction (Biering-Sorensen, 1984). In theory, core stability training will lead to better maximal power and thus more proficient use of the muscles of the shoulders, arms, and legs; better body balance; and a lesser risk of injury. Although there are still many queries that need to be answered regarding the effects of augmented core endurance/stability on serving to avert LBP, the evidence points in the direction of core endurance and stability having positive benefits for reducing LBP (Biering-Sorensen, 1984, Luoto, 1995).

Enhancing the function of the critical torso muscles in a way that spares the spine from damage serves as the training program objective. Choosing the proper exercises is critical to training program success. The next section will introduce a multi-faceted approach to core training for all sports, which includes medicine ball work, body-weight circuits, slow controlled movements, weighted abdominal exercises, dumbbell complexes, Olympic lifts, and ballistic release work.

The Exercises

Saal and Hodges describe the enormous loads on the spine during daily activities, and the role the abdominal muscles play in stabilizing the spine during these activities (Hodges, 1996; Saal, 1990). The loads on the spine increase as athletes engage in sport and the ensuing
preparatory training. Abdominal training of the local system (the group of muscles in the core that stabilizes the spine against these loads) should be the cornerstone of any core stabilization program. Isometric, dynamic and unstable training to develop the deep muscles of the abdominals involved in core stability can help protect the athlete from LBP (Hodges, 1996; Saal, 1990). Research consensus does not claim one ideal set of core training exercises, but does suggest general guidelines for exercises that emphasize trunk stabilization in a neutral spine, while also emphasizing mobility at the hips and knees (Axler, 1997, Barr, 2005, McGill, 1998). More specifically, McGill suggests that the ideal core exercise would challenge the muscle while imposing minimum spine loads with a neutral posture while challenging elements of whole body stabilization (McGill, 1998, 2002). This ideal exercise may not exist, but a multi-faceted approach may be among the best ways to benefit from core training. A multi-faceted protocol to core training with a battery of exercises that attends to the three planes of motion is as follows: (a) frontal movements, that entail lateral flexion or bending to the left and right side; (b) sagittal movements, that engage flexion and extension of the trunk in forward and backward movement; and (c) transverse movements, which involve rotary motion or twisting to the left and right (Voight & Cook, 1996). Strengthening abdominal muscles requires forcing more work than usual through overloading and also working them from a variety of angles so that all the muscle fibers are used. There is also a significant body of work demonstrating the importance of the deep abdominal musculature in providing trunk stabilization, particularly the transverse abdominals and obliques (Faries, 2007, Fredericson, 2005, Wilson, 2005).

The mesocycle sequencing of exercises begins with stability work in the general preparation phase, hypertrophy methods in the specific preparation phase, progressing into strength building methods in the pre-competitive phase, followed by neural activation methods in the competitive phase, and finally speed strength methods in the peaking phase (Poliquin, 1989; Schmidtbleicher, 1992). The key is to sequence the training modalities for developing core stability and strength during the different phases of training as a part of the total training program (Cissik, 2002). In the preparation phase, athletes begin building a strong base by performing the exercises using their body weight. When working the abdominals, work from the inside out. The main purposes of basic core strength training (training the local system) is to increase stability and to gain coordination and timing of the deep abdominal wall musculature, as well as to reduce and prevent injury (Faries, 2007; Fredericson, 2005, Wilson, 2005). The local musculature contains the diaphragm, medial fibers of external oblique, internal oblique,
multifidus, pelvic floor muscles, the quadratus lumbo-rum, and transversus abdominis (TrA) (Faries, 2007; Stanford, 2002; Whitaker, 2004). These muscles have shorter muscle lengths, attach straight to the vertebrae, and are largely responsible to generate adequate force for segmental stability of the vertebrae (Briggs, 2004; Fredericson, 2005; Stanford, 2002). One programming option is to begin with local system exercises (Table IV) that involve little to no motion through the spine and pelvis to isolate local, stabilizing muscles (Faries, 2007). It is sometime difficult to isolate the lower abdominal muscles. Another programming option for the local system is to begin with the lower abdominals and work your way up through the external obliques and upper abdominals. Since most upper abdominal and oblique exercises work both the upper and lower abdominals, the lower abdominals must be worked first if you want to isolate them.

Selected abdominal exercises that concentrate on one of the three planes of motion are programmed into the training regime during the specific preparation, pre-competitive and competitive phases including: three-position crunches, V-ups, V-ups with a twist, seated twists with a dumbbell, plate walks, side bends with dumbbells, wavings, dumbbell leg raises, back hyper-extensions, Russian twists, and delivery lifts with dumbbells (Table VI).

Symmetry of movement has also been identified in the literature as a very important aspect of spinal stabilization. Research by Grabiner (1992) has indicated that strength alone does not necessarily correlate with normal function. Subjects with LBP have consistently shown a lack of symmetry in paraspinal contraction during trunk extension (Grabiner, 1992). A programming option is to incorporate a dynamic flexibility series as part of the warm-up; leg swings, trail-leg windmills, lunge exchanges, side bends, donkey kicks, and leg whips, aids the maintenance of symmetry of movement. Hurdle drills, such as walkovers with a constant lead leg, walkovers with alternating lead leg, and multidirectional walkovers, where athletes walk over two hurdles forward and then one backward can aid in mobility and symmetry of movement.

General strength circuits (Table I) and pedestal exercises (Table IV) in the general preparation phase strengthen the core while also fostering coordination and body awareness (Judge, 2006). Stability balls (Swiss balls or physioballs) can be added to many of the general strength exercises in later mesocycles to put additional demands on the core musculature as the athlete adapts. The research of Saal, and Grabiner help substantiate stability ball use in
spine rehabilitation and conditioning (Saal, 1988; Grabiner, 1992). Cusi and colleagues used

stability ball exercises as an intervention to prevent low back and groin injuries in rugby players. In this study, players experienced fewer injuries when utilizing a stability ball training routine.

On the other hand, in a recent study by Nuzzo et. al. (2008), it was concluded that stability ball exercises may not provide a sufficient stimulus for increasing muscular strength or hypertrophy in the back extensor muscles. Thus, the role of stability ball exercises for increasing muscular strength and or hypertrophy in strength and conditioning programs is questionable (Nuzzo et al., 2008). The inability to increase the intensity of the stability ball exercises through external loading may limit muscular adaptations over a continuous period. Therefore, it is recommended that strength and conditioning programs limit the use of stability ball exercises (Nuzzo, et al., 2008).

Medicine ball exercises (Table II) can be utilized for a wide range of functional movements that strengthen the core (Judge, 2006). In the general preparation phase, begin with some very general non-ballistic medicine ball exercises for conditioning and progress to more sport-specific exercises as the athlete advances in the training cycle. Use a heavy medicine ball to develop power and a lighter ball to develop speed. Make sure that good technique is used at all times.

The hip and back muscles are developed by maximum strength building exercises such as squats, dead lifts and Olympic weightlifting exercises: clean, snatch and their derivatives (Judge, 2006). These exercises are an integral part of the year-round training program but are emphasized more in the specific preparation and pre-competitive phases. Back squats, front squats, quarter squats, overhead squats, step ups, overhead step ups, lunges, and one-legged squats, are very effective in building core strength as well as leg strength. The squat and its derivatives will require the activation of the core musculature, both local and global systems, to ensure proper spinal stability during the movement (Faries, 2007). In a recent investigation by Nuzzo et. al. (2008), it was determined utilizing integrated electromyography that muscle activity of the trunk muscles during squats and dead lifts is greater or equal to that which is produced during the stability ball exercises. Further, squats and dead lifts at intensities as low as 50% 1RM, were more challenging to the neuromuscular system than the stability ball exercises assessed in this investigation (Nuzzo et. al. 2008). Therefore, structural multi-joint
exercises like squats and dead lifts are recommended for increasing strength and hypertrophy of the back extensors (Nuzzo et al., 2008) as the intensities of these exercises can be changed through external loading. Because of the tremendous training effect received from these multi joint exercises, core training does not need additional emphasis on heavy lifting days. For the most part, core isolation exercises should be done at the end of a workout; the torso muscles play an important role in helping to stabilize the spine during key strength training movements (Voight and Cook, 1996). To allow for sufficient recovery of the torso musculature and to help prevent injuries, core isolation work should be incorporated primarily on light lifting days.

Once the stability of the local and global core musculatures has been properly trained in the preparation and pre-competitive phases, then a progressive protocol may be added, to develop the enhanced capabilities of the limb musculature in sport-specific training (Faries, 2007). Tippett and Voight indicate that determining sport-specific function requires addressing the athlete's sport-specific skills (Tippett & Voight, 1995). When developing a sport-specific program in the pre-competitive and competitive phases of training, it is important to combine sport-specific movements with resistance through appropriate ranges of motion (Axler, 1997). Voight and Cook (1996) indicate that multi-planar exercise can be used as a progression from uni-planar exercise by combing the PNF chop and lift patterns. Weight shifting, coordination, acceleration, and deceleration must be addressed not individually, but in a harmonious blend (Gambetta, 1991; Voight & Cook, 1996).

Various core exercises including derivatives of weight lifting movements can be performed with dumbbells and grouped into complexes or mini-circuits (Javorek, 1993). Many of the exercises in the dumbbell complexes are combination lifts involving pushing, pulling and squatting movements (Armstrong, 1994). Properly designed dumbbell complexes involve multi-joint activity, greatly enhancing overall coordination, timing, and the all-important element of ground reaction force (Armstrong, 1994). Dumbbell complexes are a great way to build core strength while also providing sport-specific conditioning for your athletes during the different phases of training. Exercises with dumbbells provide excellent mobility/flexibility and coordination training and are very efficient since they can be done almost anywhere, even when the athlete is traveling for games and events (Javorek, 1993). Dumbbells are also less intimidating than other free weights and are great for training through injuries.
Seven dumbbell complexes are presented that are cycled throughout the training program (Table III). Each dumbbell complex is designed with a specific purpose and use multi-joint exercises that combine external resistance with bodyweight (Javorek, 1998). The complexes include Olympic-style lifts and their derivatives, which are the best movements for developing speed and power (Armstrong, 1994). They also offer an opportunity for unilateral training, which is important in many sports activities (Javorek, 1993). Typically, athletes can perform from one to four complexes every other day and perform six to ten repetitions on each exercise. The complexes and number of repetitions performed on each exercise should change every three to four weeks as the athletes adapt. The weights of the dumbbells and number of repetitions should be adjusted for each complex based on where the athlete is in his or her training cycle or season (Javorek, 1993). Keep in mind that this type of training should be periodized and correlated with the other types of training.

The first complex, named Coffee, is designed to be a morning conditioning circuit or part of a warm-up prior to other activities. The Nirvana complex is designed to stimulate the nervous system while working the core. Included in this circuit are some ballistic movements that build speed. The Abzilla workout is a specialized complex for abdominal emphasis. Arnold is a body building complex used for general conditioning and fitness. Pre-Olympic is a great warm-up for a weight lifting workout as it contains pulling, pressing squatting, twisting and lifting exercises. London, Beijing, and Osaka are designed for developing functional strength. It is important to simulate the movements and posture encountered in the chosen activity while increasing the speed and efficiency of those movements as the training program should contain exercises that address the concept of mechanical specificity (Stone, 2007). The benefit of exercises with mechanical specificity is not limited to movement pattern or velocity considerations, but also includes peak rate of force, peak force and positional characteristic development (Stone, 2007). Also, a training exercise similar to the actual physical performance increases the probability of transfer from the weight room to the playing field. Optimum performance can be achieved when muscles are used to complement each other to create integrated movements (McCarrol, 1982).

Program Design

The integration of selected exercises into the training program requires careful planning. For optimal results, training programs generally follow a periodized method (Bartonietz, 1987; Bielik, 1984; Bompa, 1994; Fry, 1992; Stone, 2006; Stone, 2002).
Periodization can be further explained as the division of the training year to meet specific objectives to produce high levels of performance at designated times and consist of periodic changes of training objectives as well as task workload and content (Gambetta, 1991; Haff, 2004; Schmidt, 2000). The periodization of training in the core musculature focuses on optimizing the function of the local system before emphasizing movements that utilize the global system (Faries, 2007). Functional progression is the most important aspect of the core-strengthening program, which includes performance goals, a thorough history of functional activities, varied assessments, and training in all three planes of motion (Akuthota, 2004; Kroll, 2000). Training progresses through several phases, progressive in nature, in a systematic fashion, and specific to the event or sport (Cissik, 2002). The prescription of the training program will be influenced by the athlete’s skill level, training goals, as well as many other factors (Bompa, 1994; Bondarchouk, 1994; Haff, 2004).

The core-training program is organized in phases which progress from high volume of general conditioning exercises to more sport-specific exercises performed at a higher intensity and lower volume. The first phase of the core training program (general preparation phase) is designed to build endurance through static, sustained contractions in the local system (Robinson, 1992) and serves as the foundation for later postural strength and speed training. Because the literature supports the notion that endurance may be more important than strength, local muscular endurance will lay the core training foundation (Faries, 2007). We start with pedestal work as part of the warm-up (Table IV). These exercises are very similar to Pilates.

The mid-torso musculature consists of postural muscles with a high percentage of slow-twitch muscle fibers (Norris, 1999). Part of their function is to maximize trunk stability by holding contractions for extended periods, so we first focus on training these muscles. With reference to fiber typing, the local system comprises mainly type I fibers, whereas the global system mainly consists of type II fibers (Richardson, 1992; Stanford, 2002). The type I fibers of the local stabilization system have a susceptibility to grow weaker by sagging (Faries, 2007; Norris, 1999). Specificity then would necessitate local system exercises that involve diminutive to no motion through the spine and pelvis to isolate local, stabilizing muscles. Technically the coach should emphasize the importance of keeping the body in perfect alignment while holding each position. The local system is activated with low resistances and slow movements that prolong the low-intensity isometric contraction of these specific stabilizing muscles (Norris, 1999; Stanton, 2002). Examples of these local system exercises are listed in Table IV.
After an athlete has developed the ability to maintain efficient postures while performing very simple motor tasks, we find they are able to develop more advanced skills at a quicker rate. This agrees with the Schema theory of Schmidt (Schmidt, 1975). Schmidt proposes through the Schema Theory that skill learning is a process of recall and recognition. Schema learning occurs as the motor program stores information such as body position, skill parameters, accuracy, and sensory input (Schmidt, 1975). At the same time, the risk of long-term repetitive injury patterns—many of which result from improper posture—is reduced (Faries, 2007).

The second stage is the pre-competitive stage, when the focus turns to building strength. In my coaching experience, strength is often a limiting factor in developing optimal technique required for the sport. Indeed we have noted that the stronger athletes are able to develop technique faster and refine technique to a greater extent than weaker athletes (Stone, 2002). Various approaches to core strength development have arisen from the coaching, scientific and physiotherapy communities (Faries, 2007). It is interesting to note, in a recent review by Warren Young which demonstrated little transfer between pure strength gains and athletic performance; combination training is necessary to fully develop power and performance (Young, 2006).

Once the athlete can perform acceptable slow isotonic mid-torso exercises, additional exercises that demand balance utilizing the global system can be introduced (Faries, 2007). Global muscles (sometimes classified as “slings”) have long levers and large moment arms, making them able to produce high outputs of torque, while countering external loads for transfer to the local musculature (Faries, 2007; Fredericson, 2005; Stanford, 2002). These muscles include the erector spinae, lateral fibers of the external oblique, psoas major, and the rectus abdominis (Faries, 2007). A wide repertoire of activities can be used to enhance functional postural integrity, and as a result latent power resources. The global system, consisting of more type II fibers that generate movement of the spine, may be emphasized through exercises that engage more dynamic eccentric and concentric movement of the spine through a full range of motion (Faries, 2007). Conditioning regimens using body weight exercises, medicine ball throws, sprint drills and low level jumps are progressively integrated into the pre-competitive phase program. For the beginner, it is recommended to start the transition with body-weight exercises and movements. Traditional exercises, such as the sit-up, focus on enhancing the capacity of this global musculature (Faries, 2007). Keep in mind, these
exercises emphasize the global systems, not isolate the global systems, because both systems theoretically work in synergism (Cholewicki, 2002). These types of exercises not only emphasize the global system, but also create an environment for the local system to begin to stabilize the spine in varying, multi-planar movements. Rapid movement and higher resistances also will recruit these global muscles, especially the rectus abdominus (Norris, 1999).

Following mastery, resistance (Table VI) can be added to each exercise and should be increased in a controlled progression as the athlete adapts to the resistance. Exercising the core for an emphasis in strength would consist of high load, low repetition tasks, while endurance development requires general, less technically challenging exercises at higher volumes and lower intensities (McGill, 1998). A simple method to outline a progression for the global musculature of the core is to have the athletes begin by selecting a weight they can handle for ten repetitions, and then increase the number of repetitions until they are able to use that same weight to complete 20 repetitions. The resistance is then increased to a weight that the athletes again can only comfortably complete ten repetitions. The core training program is conceptually based on the stimulus-fatigue-recovery-adaptation model in which an appropriate stimulus can result in fatigue-recovery, an adaptation, and performance enhancement (i.e., supercompensation) (Behm, 1995; Haff & Potteiger, 2001; Leetun, 2004).

Explosive speed strength training is the final ingredient in the core-development program and coincides with the beginning of the competitive stage. Various training schemes using multi-throws, plyometrics, and sprint drills are implemented with different volumes and intensities; rest-to-work ratios are influenced by training age, time of the season, and skill parameters (Bompa, 1994; Pedemonte, 1986). The sprint drills emphasize horizontal movements through space where limbs are worked through various ranges of movement under varying thresholds of velocities and force. Multiple throw and multiple jump exercises involve various rotations, flexion/extension factors, and both intra- and inter-muscular coordination (Table V).

Even as progression aims to challenge the core musculature in environments similar to those of competition, it may be wise to begin slowly. Always consider this possibility: sufficiently training the local musculature. The types of explosive exercises in this phase can potentially create a situation where force is being produced by the global muscles that in some cases cannot be controlled and handled by the local musculature (Faries, 2007). It is imperative
to maintain correct technique regardless of training load, for both safety and performance purposes. Winchester et al. (2005) was able to demonstrate that at the same training load, power output can be significantly improved through improved technique in the power clean exercise (Winchester, 2005). If fatigue compromises form, it's time to reduce the load or terminate the exercise.

In addition to the sprint drills, throws, and jumps, the workout contains sport-specific release movements that force core stabilization of high velocity activities. For example, to work on acceleration, athletes perform different types of releases with one and two arms. Sport-specific medicine ball exercises that mirror sport-specific release parameters are an effective way to build strength. Heavy weights (20 or 25 pounds) are used for power and lighter weights for speed. These exercises are designed to emulate key sport specific positions. In addition to the speed strength gains, these types of exercises may offer a challenge to postural integrity. Keep in mind physiological adaptations and skill acquisitions occur in multiple areas and are for the most part unrelated (Jensen, 2005). These special exercises must be combined with ongoing sport-specific technical work.

Conclusion

As its name implies, the core is at the center of most sports movements. Whether it’s transferring energy from one area of the body to another or maintaining stability and balance while using the extremities, the core is under nearly constant stress in athletics. Coaches in all sports must include core training as part of their daily training regimen. A multi-faceted approach that addresses the three planes of movement combining medicine-ball work, body-weight circuits, controlled movements, abdominal exercises, dumbbell complexes, and Olympic weight lifting exercises can provide physiological and biomechanical core advantages that enhance performance in most every sport. Because of the core’s global importance in sport, coach’s education programs must address core training and formulating a periodized core training program. Above all, coach educators must ground core training philosophies in research.
Table I - General Strength Circuits

Below are two sample general strength circuits used to strengthen the core. The first circuit is designed for use in open areas while the second uses weight room exercises. A Swiss ball can be added to many of the exercises to increase the difficulty for more advanced athletes.

Cowboy (Outside circuit)
Crunches x30
Clap push-ups x10
Leg toss x20
Push-ups x15
V-ups x20
Leg scissors x20 in & x20 out
Push-up toe walk x10
Side crunch x10 each side
Decline push-ups x10
Wrestler’s bridge x5
Single leg squats x10 each leg

Cowgirl (Weight-room circuit)
Hanging leg raise x30
Chin-ups x10
Roman chair sit-up x20
Dips x15
Russian twists x20
Lunge walk 10 steps
Table II - Medicine Ball Exercises

Albert is a short in-season set of medicine ball exercises. Alberta is a more extensive set used during the pre-competitive phase. Athletes should complete ten repetitions of each exercise, starting with a three-kilogram ball and increasing the weight once they can finish each repetition under complete control.

Albert (In-season workout)
- Catch and throw
- Back-to-back partner pass
- Over-and-under pass
- Sit-ups
- Seat-side throw

Alberta (Pre-competitive phase workout)
- Hip catch-toss
- Mb good morning
- Mb v-sit
- Catch and throw
- Hurdle reach
- Partner-exchange hip
- Prone catch-and-toss
- Knee toss
- Seated roll
- Arm-add-abs
### Table III - Dumbbell Complexes

Each of the following seven dumbbell complexes are designed for a specific purpose and are rotated through the training program. Sets of six repetitions are generally recommended. Weights and repetitions will vary based on the athlete’s training schedule.

<table>
<thead>
<tr>
<th>Coffee (Warm-up)</th>
<th>Twists behind the back</th>
<th>Nirvana (Nervous system)</th>
<th>Beijing (Functional strength)</th>
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<td>Bent rows</td>
<td>Wavings</td>
<td>Arnold (Body building)</td>
<td>Lunge Press</td>
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<tr>
<td>Twists behind the back</td>
<td>Antennas</td>
<td>Bent rows</td>
<td>High Pull</td>
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<td>High pulls</td>
<td>Releases</td>
<td>Upward rows</td>
<td>Dumbbell snatch</td>
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<td>Seated twists</td>
<td>Plate walks</td>
<td>Tricep extensions</td>
<td>Wavings</td>
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<td>Squat presses</td>
<td>Swings</td>
<td>Squats</td>
<td>V-up twist</td>
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<td>Plate walks</td>
<td>Good mornings</td>
<td>Standing calf extensions</td>
<td>Squat jumps</td>
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<td>One-arm snatches</td>
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<td>Shrug</td>
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<td><em>Nirvana (Nervous system)</em></td>
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<td>Shrugs</td>
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<td>High pulls</td>
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<td>Jump shrugs</td>
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<td>Squat presses</td>
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<td>Snatches</td>
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<td>Clean-and-jerks</td>
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<td>One-arm snatches</td>
<td>Pre-Olympic (Olympic</td>
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<td>One-arm jerks</td>
<td><em>weight lifting warm-up</em></td>
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<td>Step ups</td>
<td>Squat press</td>
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<td>Push jerks</td>
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<td>Jerk</td>
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<td><em>Abzilla (Abdominals)</em></td>
<td>Seated twist</td>
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<td>Seated twists</td>
<td>Delivery lift</td>
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<th>London (Functional strength)</th>
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<td>Squat punch</td>
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<td>Side snatch</td>
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<td>Side bend</td>
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<td>Around the world</td>
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<td>1 arm jerk</td>
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<th>Osaka (Functional strength)</th>
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<tbody>
<tr>
<td>Overhead Squat</td>
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<td>1 arm snatch</td>
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Table IV - Stability Circuit

The core-training program begins with pedestal exercises that maximize trunk stability in the local system. Beginning athletes should start by holding each position in perfect alignment for ten seconds. Once that is accomplished, athletes should progress to doing ten repetitions of ten seconds for each position. A Swiss ball can be added for the advanced athlete.

Six Pack (Pedestal Work)
Prone elbow stand, single-leg raise
Supine elbow stand, single-leg raise
Prone hand stand, single-leg raise
Supine hand stand, single-leg raise
Lateral elbow stand, single-leg raise
Lateral hand stand, single-leg raise
Prone flexed knee, elbow stand, hip lift
Supine flexed knee, hip lift
Crunch, low reach (slow)
Crunch, low reach with twist (slow)
Table V - Conditioning and Speed Strength Exercises (Pre-competitive and Competitive Stage)

Sample sprint drill, throws, and jumps workouts are listed below.

**Gamecock (Warm-up A)**
- Skip with cross arms forward and back
- Windmill skip forward and back
- Crossover skip
- Alternate side shuffle
- Carioca
- Strides

**Sycamore (Multi-throw circuit #1)**
- Overhead back
- Between the legs forward
- Toe board chest pass explosion
- Releases right-handed and left-handed

**Cardinal (Multi-jump circuit #1)**
- Star jumps
- 180-360 jumps
- Speed skater
- Line hops
- Dynamic step-ups
- Single-leg butt kick
Table VI - Abdominal Exercises

Many of these exercises work the global as well as the local system. All exercises performed with body weight first. Add resistance as fitness improves. Start with ten repetitions and continue with the same weight until the athlete can perform 15-20 repetitions, then increase resistance.

Frontal movements - Entail lateral flexion or bending to the left and right side.
- Standing Dumbbell Side Bends
- Wavings
- Lying side crunch

Sagittal movements - Engage flexion and extension of the trunk in forward and backward movement.
- Three position crunch
- V-up
- Lying dumbbell leg raise
- Lying Swiss ball leg raise
- Hanging straight leg raise
- Hanging bent leg raise
- Incline sit-up
- Back hyper extension

Transverse movements - Involve rotary motion or twisting to the left and right.
- V-up Twist
- Seated Twist with dumbbell
- Seated twist with barbell
- Plate walk
- Standing twist
- Twist behind the back
- Russian twist
- Swiss ball twist
Multi-plane movements
- Delivery lift with dumbbell
- Incline sit-up with twist
- Walking chop with Medicine ball
- Cable chop
References


