

SSE Roundtable #47: Core Strength Training

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Core Strength Training

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KEY POINTS

- The core musculature includes the muscles of the trunk and pelvis that are responsible for maintaining the stability of the spine and pelvis and are critical for the transfer of energy from large to small body parts during many sport activities.
- Theoretically, core strength training will lead to greater maximal power yet more efficient use of the muscles of the shoulders, arms, and legs, better body balance, and a lower risk of injury.
- Although the core muscles can be strengthened with traditional weight-training exercises, conditioning exercises should eventually mimic the dynamic movements of sport.
- Keys to successful core strengthening programs include selecting sport-specific exercises that overload both anterior and posterior muscles of the trunk and pelvis and emphasize repeated explosive movement.

INTRODUCTION

In the last few years many strength training programs have evolved to emphasize strengthening muscles of the core, that is, muscles of the trunk and pelvis?the "core" of the body?in addition to the muscles of the shoulders, arms, and legs. Core training, especially for athletes, should be specific to the required sports skills; thus, particular muscle groups in the core may be more or less important for a given individual. These groups include the abdominals (*rectus abdominis*, *transversus abdominis*, *internal* and *external abdominal obliques*), hip musculature (*iliopsoas*; *rectus femoris*; *sartorius*; *tensor fasciae latae*;

pectineus; gluteus maximus, medius and minimus; semitendinosus; semimembranosus; biceps femoris; adductor brevis, longus, and magnus; gemellus superior and inferior; obturator internus and externus; quadratus femoris; piriformis), and spinal musculature (erector spinae; quadratus lumborum; paraspinals; trapezius; psoas major; quadratus lumborum; multifidus; iliocostalis lumborum and thoracis; rotatores; latissimus dorsi; and serratus anterior).

What are the advantages of core strength training? What equipment, if any, is required for this type of training? What is the evidence that core strength training is more effective than more traditional types of strength training? These are some of the questions we asked our panel of strength training experts.

Skip Allen has coached and taught strength and conditioning theory and practice for more than 17 years. In 1996 the International Sports Sciences Association named him Strength Coach of the Year. He formerly was a strength and conditioning coach with the Denver Broncos, Detroit Lions, Denver Nuggets, and the Colorado Avalanche. Skip has coached John Elway, Barry Sanders, Tony Dorsett, and many other professional and collegiate athletes.

Dr. Dudley has been engaged in research and teaching concerning resistance training for the past two decades. He received the President's Award of The National Strength and Conditioning Association in 1986 and the Outstanding Sport Scientist Award of that organization in 1996. He has worked with the US Olympic Committee, the American College of Sports Medicine, and the National Strength and Conditioning Association on issues related to strength training.

Mike Iosia has directed the strength and conditioning program for all athletes at Tulane University for the past three years and has personally directed the in-season and off-season workout program for the Tulane University football team since 1998. He previously served three years on the strength and conditioning staff at Auburn University. He was an intercollegiate football player at Canisius College and at Southern Mississippi, and he played in the 1993 Senior Bowl.

Dixie Stanforth has taught physical activity and health promotion classes at The University of Texas since 1985 and has established a successful business as a personal trainer in Austin. She shares her expertise in fitness as a consultant to many certifying organizations, corporations, and other agencies, including serving as a member of the Board of Advisors for Science and Education of the Gatorade Sports Science Institute. She is a fitness editor for *Shape* magazine and a spokesperson for the American Council on Exercise. Dixie has also published research articles on physical fitness and has co-authored a book on aerobic dance exercise.

Brent Steuerwald has been a varsity high-school football coach for 43 years. In 1995 the National High School Athletic Coaches Association named him National Coach of the Year in Football. He works with the National Football League in developing educational programs to improve football coaching across the nation.

What has led to the recent surge in interest in strengthening the core muscles of the body?

STANFORTH: Training the trunk and pelvic muscles has always been part of the strengthening programs for athletes. You generate your power from the hips ? thus it makes sense to focus on the core. The recent buzz about "functional" training ? trying to make training as performance-specific and applicable to real life as possible ? has led to an increased recognition of the need to target the core of the body for specific training. Within the fitness industry, several commercial entities have developed specialized equipment and integrated core-conditioning programs that have affected the fields of group exercise and

personal training, bringing "core training" to the masses.

IOSIA: Dixie is right. The strengthening of the trunk and pelvic muscles has always been important. The uniqueness of most core training programs is exercising the lower back and abdominal muscles in unison.

STEUERWALD: The recent focus on core strength training is also the result of a greater emphasis that has been placed on training for dynamic, multi-plane/multi-directional movements. These movements are more efficiently developed when core strength training and proprioception exercises are utilized.

DUDLEY: Another factor that has been important is a greater appreciation of the fact that most physical activities require transfer of energy from large to small muscle groups in an efficient manner. This has raised interest in the possibility of limiting injury, enhancing rehabilitation, and/or improving performance by conditioning the muscles of the core in a sport-related manner.

What is the rationale for emphasizing the core muscle groups in strength training programs for athletes?

ALLEN: When athletes produce the necessary movements in their sports with increased efficiency, their performance improves; better core strength can enhance this efficiency of movement. Greater strength of the core musculature increases the stability of the pelvis and spine and improves body control or balance during athletic movements. This helps the athlete generate greater power output, not only from the core musculature, but also from the peripheral muscles of the shoulders, arms, and legs because many of these muscles are anchored to the spine or pelvis. When the spine and pelvis are more stable, the peripheral muscles are biomechanically more effective.

STANFORTH: To expand on Skip's comments, it is important to train the core muscles because the torso is used either actively or as a stabilizer in just about any athletic movement; thus, it makes sense to target those muscles for strength training. More importantly, those muscles should not be trained exclusively in isolation because they work in an integrated fashion to perform whole movements. For example, when you try to improve a golfer's tee shot, you don't think about strengthening individual muscles but rather all the muscles involved in creating movement patterns or movement segments involved in the stroke.

STEUERWALD: I agree that core strength training can enhance neuromuscular efficiency and that this can lead to improved athletic performance. Moreover, with a stronger core, less forceful contractions of the peripheral muscles are required to produce a given amount of power, so the muscles—both in the core and in the periphery—are less likely to be injured during training and competition.

IOSIA: I have always trained the abdominals and lower back muscles of athletes to ensure proper technique and injury prevention when they perform squats and Olympic lifts. More recently, I have incorporated extensive core training routines to improve running form, balance while making quick changes of direction, and stability while absorbing contact from opponents in football and wrestling.

DUDLEY: Many sport-related injuries are caused by poor mechanics of movement. For example, an injury to the arm of a baseball pitcher might occur if the pitcher fails to bring the muscles of the trunk into the throwing action, thereby placing too much strain on the arm muscles. This suggests that improved throwing technique must be learned and that the trunk musculature should be strengthened. As a result, performance might be improved and the risk of injury reduced.

Why are the terms "stabilization" and "balance" so often mentioned in association with core strength training?

IOSIA: One of the main reasons for strengthening the core muscles is to provide a more stable platform for the actions of the peripheral muscles of the shoulders, arms, and legs. Stronger core muscles can better stabilize the spine and pelvis during strenuous athletic movements. This provides a more solid biomechanically efficient platform for the peripheral muscles attached to the spine and pelvis. When they are anchored solidly, more of the force produced by the peripheral muscles is presumably directed to moving the limbs and less to unwanted movements of the spine and pelvis.

ALLEN: A second reason for strengthening the core musculature is to enhance overall body balance during athletic movements. For example, a wrestler who has weak core muscles is more likely to be forced into an off-balance or unstable position by the opponent. When off balance, the wrestler's arm and leg muscles cannot operate with optimal biomechanical efficiency, and the opponent is then more likely to score points. The best way to emphasize improved balance while strengthening the core muscles is to train in an unstable environment. In wrestling, this is best done by performing wrestling drills with a training partner who provides unexpected and varying levels of resistance—forward, backward, laterally, and vertically. In other sports, unstable surfaces can be created with foam pads and rollers, balance boards, stability balls, etc.

STANFORTH: Stability and balance are critical to real-life performance and movement. Let's look at the lunge as one exercise generally considered to be an effective multi-joint, multi-muscle exercise that is common to many sports. Performed traditionally in a weight room, the athlete holds dumbbells or a barbell and does the exercise in a controlled, linear fashion. But in the real world—lunging cross court for a tennis ball, lunging on a deep diagonal at short stop to field a ground ball, lunging for a tackle as a running back approaches in football, diving for a loose ball in basketball—the lunge is very dynamic and uses many muscles not trained in a traditional exercise setting. Adding the components of balance and stabilization are attempts to make the training more sport-specific and functional. Thus, you might see athletes performing lunges on foam pads or using medicine balls to add resistance to rotation and diagonal movements of the trunk.

STEUERWALD: As Dixie implied, training the nervous system plays a vital role in improving balance and stabilization. Proprioception is the ability of the nervous system to instantly determine the relative positions in space of all of the limbs and other components of the body and to thereby help the brain make appropriate neuromuscular adjustments. When strength training takes place in unstable environments, the nervous system becomes better able to make appropriate neuromuscular adjustments to the instability.

Why are stability balls, foam pads, balance boards, and other types of equipment often used in core strength training? Is this type of equipment essential?

STEUERWALD: Stability balls, medicine balls, and foam rolls can provide a more dynamic training environment. When properly designed, exercises that use this type of equipment can result in movements that are somewhat similar to those experienced in athletic situations. In other words, properly chosen exercises can be fairly specific to a given sport. However, although such equipment can be helpful, it is not essential. Core strength can be developed with more traditional types of resistance training and floor exercises and by using the varied resistance provided by training partners.

STANFORTH: Traditional training tends to be linear with movements performed in a single plane. Equipment that challenges the athlete to achieve balance and stability while performing sport-specific movements enables them to train the core of the body in a functional manner. This can help train the muscles in the ways they will be used during performance on uneven surfaces, in all three planes of movement, and with diagonals and

rotation. Is this type of equipment absolutely required? No.

What are some key tips for successful strengthening of the body core?

STANFORTH: As with any strength-training program designed to improve sport performance, it is critical to analyze exactly how the various movements in the sport should be performed and then to attempt to develop resistance-training exercises that closely resemble those "ideal" movements. (This is the so-called "specificity" principle of training.) Also, I encourage anyone who wants to improve core strength to use movements that are multi-planar and that include diagonal and rotation movements of the trunk. Finally, to minimize injury and to expand the types of movements that can be performed in sport, it is important to emphasize flexibility in training routines as much as strength.

ALLEN: I always stress proper foot placement (balance) when performing resisted movements because without optimal balance, the athlete cannot produce optimal force and power. In addition, many injuries result from poor balance. Second, I believe that most athletes should employ explosive power movements during resistance training more than slower movements that rely on absolute strength. The reason for this is that most movements in sports require explosive power rather than brute strength. Third, I emphasize compliance and consistency in training. It is crucial that athletes participate in every scheduled training session to establish a solid foundation and that they perform the exercises recommended by a qualified strength coach or personal trainer. These are the essential ingredients to developing a powerful and healthy sport-specific athlete.

IOSIA: To get the most from resistance training, athletes must use proper form when performing each exercise. If they do not use proper form, they will not adequately overload the specific muscles for which the exercise is designed. Also, when recommending training routines for the core muscles, which are active throughout the day while maintaining posture, I suggest performing many repetitions against moderate resistance rather than using heavy loads with few repetitions. It is also important to choose the correct sequence of exercises for core strength training. I advise athletes to first perform exercises that alternately overload back extensors and abdominal muscles and follow that with exercises that work these muscle groups separately.

STEUERWALD: If I had to pick three key points they would be as follows. First, athletes should strive to maintain a balance of strength between agonist and antagonist muscle groups. If they emphasize muscles on only one side of a joint, they are setting themselves up for injury. Second, athletes should perform exercises in several planes and/or directions to mimic what occurs in competition. Third, optimal training results will come when athletes combine proprioception training along with strength training activities.

DUDLEY: In resistance training it is critical that the chosen load and the volume (repetitions, sets, and frequency) are optimal?too little or too much of either and the adaptive response will be poor. Also, I agree that it is best to mimic the physical requirements of the sport as closely as possible for ideal training.

What are some of the exercises that are most crucial to a successful core-strengthening program?

STEUERWALD: Five important core-training exercises are: pelvic tilts, abdominal crunches, bridging, leg presses, and latissimus dorsi pull-downs. These exercises target the major muscle groups that have attachments to the pelvis, lumbar, and thoracic spine.

IOSIA: I agree with Brent that bridging exercises are key. Here are some details about some bridges that can be performed on a floor mat (or on a stability ball).

Prone Bridge (Bows and Toes)

In a prone position on a floor mat, the athlete balances on the tips of toes and elbows while attempting to maintain a straight line from heels to head. This exercise focuses on both the anterior and posterior muscle groups of the trunk and pelvis.

Lateral Bridge (Bridge Right and Bridge Left)

In a sideways posture on a floor mat, the athlete balances on one elbow and the side of one foot while attempting to keep the body aligned in a straight line. This exercise focuses on the abdominal obliques and transversus abdominus. Also, the lateral bridge teaches the athlete how to sense the proper pelvic position.

Supine Bridge

In a supine posture on a floor mat, the athlete raises the hips so that only the head, shoulders, and feet are touching the mat. The supine bridge focuses on the gluteal muscles. Stronger gluteals help maintain pelvic control, which is important for movements that require hip extension.

ALLEN: I'm not so sure that any one exercise or group of exercises is necessarily best. A variety of exercise movements is critical in developing the core muscle groups. Examples of some excellent activities are single-leg movements combined with other core exercises, eccentric movements, pike movements on a stability ball, and trunk rotation exercises with medicine balls.

What is the evidence that core strength training is more effective than traditional training programs?

STANFORTH: We have to rely mostly on anecdotes and personal experience because there has been little research done on this topic. Intuitively, it makes a lot of sense to incorporate core training into strength programs, but we can't make the case that it should be done to the exclusion of "traditional training" programs. Many "traditional" programs also include significant amounts of core training, but perhaps this core training could be more effective. For example, rather than focusing on doing thousands of crunches on the floor?using a posture you never experience in sport on a flat, non-moving surface?you could substitute abdominal progressions on a stability ball or utilize a medicine ball in a variety of different ways.

ALLEN: To my knowledge, Nadler et al. (2002) published the only study of the effects of core strength training. They were unable to detect any significant effect of core training on the incidence of lower back pain in Division I university athletes. However, the number of athletes who required treatment for low back pain was small (14 of 236 total subjects), so it would have been very difficult to show a significant effect. As Dixie said, most of the evidence in support of core strength training is observational and anecdotal. For example, after his back surgery Joe Montana used core training in his rehabilitation program so that he could resume playing. He was one of the first pro athletes to be recognized as having used core training to his benefit.

STEUERWALD: I certainly have not done any formal research on this issue, but I have observed over several years that when my players have undergone core strength training, they seem to have greater overall strength, balance, power, and efficiency in competition. In football, applying force in a one-dimensional plane is not the norm. Improved core strength allows athletes to adapt to the needs of the game and play more effectively.

SUGGESTED ADDITIONAL RESOURCES

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Video examples of exercises using medicine balls (2002).

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Strengthening Your Body's Core



Many of the major muscles of your shoulders, arms, and legs are attached to the pelvic bones and/or the spine, the core. If your trunk muscles are well conditioned, you will enjoy optimal transfer of energy from large to small muscles when you sprint, twist, lift, jump, throw, and perform other movements in your sport. Moreover, if the core is well trained, you are less likely to be injured in training or competition. What's the best way to strengthen your core? Here are some tips recommended by strength coaches and other training experts.

- Perform core training at the beginning of each workout and make certain that you select exercises that are safe but challenging to your nerves, muscles, and bones.
- Begin your core training with simple traditional exercises—abdominal crunches, back extensions, squat lifts, deadlifts, leg presses, lunges, leg raises, bridging exercises, pull-ups, and pull-downs—that stress the core muscles.
- As you improve, progress to more complex exercises that more closely mimic the specific dynamic movements required in your sport. For example, football linemen might practice driving off the line of scrimmage against larger team members, and wrestlers might participate in escape drills against training partners who provide

varied resistance to the movements. Training with partners who provide unpredictable resistance in varying directions at varying speed helps train both your muscles and your nervous system to react quickly to changing environments.

- In the early stages of your training perform the exercises at controlled rates with light to moderate resistance. This helps build up your muscles and joints so that you will be less susceptible to injury. Later, you should progress to more explosive movements against heavier loads, similar to those you might encounter during competition in your sport.
- Vary the movements and the types of resistance that must be overcome. This will reduce boredom and risk of injury and will help you stick to your training regimen.
- Always perform your exercises exactly as they are meant to be performed and establish proper body balance while doing so. This will not only enable you to get the most out of your training, but it will also help minimize your risk of injury.
- Consider performing some of your exercises on unstable surfaces such as foam mats or balance boards to improve your body's ability to achieve stability and balance in the changing environments of sport.
- Consider performing trunk rotations and trunk flexions/extensions with medicine balls and using rubber band devices as resistance tools. This may more closely mimic the changing resistances you encounter in your sport compared to using dumbbells and barbells.
- Don't exercise one body part to the exclusion of others. In other words, spend as much time training the muscles of your back as you do the muscles of your abdomen. Otherwise, you are less likely to achieve optimal stability of your spine and pelvis and you are more likely to be injured because of an imbalance of muscle strength.
- Improve the flexibility of your trunk and hips. Increasing your flexibility will help extend the range over which you can perform your movements and may decrease your chances of being injured.
- Be consistent in your training. If you stick with your training plan, you are much more likely to achieve success than if you train erratically.

SUGGESTED RESOURCES

Brittenham, G., and D. Brittenham (1997). *Stronger Abs and Back*. Champaign, IL: Human Kinetics Pub, 248 pp.

Video examples of exercises using medicine balls (2002).

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