Connecting the Core

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Athletes have been inundated with terminology and references to "core" development in recent years. However, little has been conveyed to these athletes on what qualifies as the core, and how to specifically target muscles that may be beyond the scope of the commonly referred regions. Although major muscles groups are important in the function of the abdominals and the back, there are many other muscles that need to be specifically addressed to ensure the core is developed completely. If the core is underdeveloped or inefficiently trained, subsequent injuries or detriments to performance may occur (see Figure 1).

Table 1. Prospective Injuries and Performance Detriments Caused by an Underdeveloped Core.

Prospective Injuries
Lower Back Pain—lower lumbar and/or sacroiliac joints
Abdominal strains
Groin strains
Hip Flexor/abductor/adductor strains
Pelvic misalignment
Compensation musculoskeletal injuries
Prospective Performance Detriments
Poor gait mechanics
Poor postural alignment
Poor transferability of force from lower to upper extremities and vice versa
Inability to decelerate/accelerate with minimal loss of speed and force
Inability to withstand and balance external forces

Rationale

The goal of learning the specific muscles of the core is to enable individuals to have the knowledge to correctly assess where they may be deficient. Simply knowing where a deficiency is located is half of the task, the other half lies with developing exercises that will address those areas. This will then facilitate the process of becoming increasingly stable and efficient in overall core development.

Programs have developed beyond simply upper body and lower body routines. Integrated designs of programs now incorporate many methods and mechanisms to increase speed, power, and strength. Many structural lifts (e.g. cleans and squats) do integrate the core structure and aid to develop anterior and posterior development. However, even with the progression of programs to more complex training, specific core training is still, at times, not at the forefront of those programs. Often core training is programmed at the conclusion of a training session. However, this is when you may not be capable of performing specific movements to the degree of specificity needed. This can be attributed to physical and mental fatigue. Therefore, it is suggested to incorporate core training as the precursor to training sessions. Specific core stabilization and dynamic movements can be a neuromuscular stimulant, aiding in more ballistic strength, speed, and power movements.

Physiology

There is a common inference that the core is comprised of solely the abdominals and lower back. More specifically, the abdominal wall, consisting of the rectus abdominus, internal and external obliques, and the transverse abdominus, has been the primary focus in many core definitions and routines. These three muscle groups are responsible for a broad scope of functional movements: flexion, extension, rotation, lateral bending, as well as compression of the trunk. These muscles work in conjunction with one another to create movement of the trunk in the three planes (frontal, sagittal, and transverse), but also act to stabilize and support the spine during dynamic movements. However, the scope of the core definition and responses to movement cannot be limited within these three muscles.

The lumbo-pelvic-hip (LPH) complex is a conglomeration of 29 different muscles that attach to the core. This complex musculature is responsible for stabilizing, transferring, reducing, and producing force during closed kinetic chain movements (where the foot is in contact with a solid surface such as the ground). In addition, the muscles of the LPH complex are responsible for maintaining balance, and serve as a base of support over the center of gravity during functional range of motion movements. Open chain movements, (where the foot is not in contact with a surface), entails less dynamic movement, consequently diminishing the activity of the LPH.

The multifidus, which is one of the muscles of the LPH, is responsible for stabilizing the spine and pelvis directly prior to movement of the limbs. This muscle works in conjunction with the transverse abdominus to perform this preparatory action. The muscles of the pelvic floor are also fully activated during this segment of movement. The pelvic floor is also responsible for support of the pelvic organs and abdominal contents, especially when standing and exerting force during movement. However, the transverse abdominus and the multifidus are the only muscles active during all trunk motions.

Two other muscles of this region that are of vital importance for core development are the psoas and the iliacus. These two muscles are commonly referred to as, or in connection with, the hip flexors (iliopsoas) due to the common insertion they maintain at the femur. The psoas also connects to the lumbar region of the spine, and is responsible for flexion of the trunk, rotation of the femur, and flexion of the hip with the iliacus. The reason these muscles are of vital importance in terms of core development is due to their significance in terms of commonality of injury. If the iliopsoas is progressively shortened, injury to the lower back can acutely or chronically occur. Similarly, the psoas originates in the spine at the same location as the latissimus dorsi. Due to this intersection, if the shortened iliopsoas pulls on the common junction of the latissimus dorsi, this can then pull on the levator scapula, causing shoulder issues. Therefore, when developing a program that incorporates flexion movements, it is necessary to compliment the shortening activities with extension and lengthening techniques.

It is necessary to emphasize the importance of comprehensive core development around this pelvic region, especially for sports that involve rapid acceleration of the lower limbs, as well as abduction and external rotation about the hip. A condition known as osteitis pubis is consistently seen in sports such as hockey, soccer, hurdling, and football (especially kickers/defensive backs). This is a condition that is caused by abnormal shearing forces across the pubic symphysis. The pubic symphysis is a cartilage joint that connects the pubic bones within the pelvis. The condition stems from an elongation and/or a weakness of the adductors that can be coupled with poor flexibility of the pelvis and sacroiliac joints. The condition can feel similar to a groin strain but generally emanates from the lower abdominals, and can consequently cause discomfort in this region as well. The issue here is to ensure the adductors and abductors of the hip are strengthened, while also maintaining a degree of flexibility about the groin.

Many athletes experience lower lumbar discomfort as a common ailment of training and or competing. This can be attributed to the vast amount of muscles that surround and intersect within this region, and that have the possibility of being overlooked in the core program. Subsequently, in combination with the pelvic stabilization and strengthening, activity of the gluteus medius, gluteus maximus, and piriformis should be programmed to completely stimulate and stabilize the posterior aspect of the hip and pelvis. If too much attention is spent on the anterior musculature (abdominals) then muscle imbalances can be incurred, which can lead to the aforementioned conditions and other strains throughout the core region as well.

Introductory Programming

The following section provides an introductory 10-week progression of exercises that address the issues presented. To increase intensity for these exercises, increase the time under tension versus solely increasing the repetitions. Always emphasize the technical aspect of "drawing in" (a technique of tilting the pelvis and bringing the abdominal wall back towards the spine) and a flat neutral spine to activate the muscles of the entire core. These routines and exercises are not comprehensive, but are fundamental to establishing a base of core development and can be performed two-three times per week, depending upon the level of core development.

Table 1. Routine (weeks 1 – 3)

Exercise	Time and Repetitions	Progression
Plane Holds (Elbows)	0:30 sec each side /0:45 sec front	0:60 sec each side /0:120 sec front
45-Degree Hold	0:30 sec	0:45 sec
Dead Bug (90-Degree)	0:40 sec	0:60 sec
Alternating Crunch Hold	4 x 0:05 sec each side	3 x 0:10 sec each side
Reverse Incline Plane	0:30 sec	0:60 sec
Glute Hold	0:40 sec	0:60 sec
Prone Pass	2 x 8 repetitions	2 x 12 repetitions

Table 2. Routine (weeks 4 – 6)

Exercise	Time and Repetitions
Plane Holds (Hands) with Leg Lifts	Begin with both feet down for 0:20 sec. Then lift the leg and hold for 20 sec, perform for both sides. Move to the front position and hold for 20 sec. Then perform 2 x 0:10 sec lift and holds for each leg in the front position, completing the drill with another 0:20 sec hold with both feet down in the front position.
45-Degree Hold	0:45 sec hold
Dead Bug (90-Degree)	0:50 sec hold
Alternating Crunch Hold	3 x 0:10 sec holds on each side
Dead Bug (Extended)	0:40 sec hold
Reverse Incline Plane with Leg Lifts	0:15 sec hold with both feet down, followed by 2 x 0:10 sec lift and holds for each leg, finishing with a 0:15 sec hold with both feet down.
Prone Pass	12 repetitions
Glute Hold with Leg Lifts	0:20 sec hold with both feet down, followed by 2 x 0:05 sec lift and holds for each foot, finishing with a 0:15 sec hold with both feet down.
Prone Pass	12 repetitions

Table 3. Routine (weeks 7 – 10)

Exercise	Time and Repetitions
Bench Bridge with Arm Lifts	Begin with both arms down, holding for 0:10 sec, followed by 3 x 0:07 sec lift and holds for each arm, finishing with a 0:15 sec hold with both arms down.
Plane Holds (elbows) with Leg Lifts (Sides Only)	2 x 0:15 sec holds with both feet down, followed by 0:15 sec lifts. Perform for both sides.
Dead Bug (Extended)	0:45 sec hold
45-Degree Hold	0:45 sec hold
Alternating Crunch Hold	3 x 0:10 sec holds on each side
Dead Bug (90-Degree)	0:40 sec hold
Prone Pass	15 repetitions
Glute Hold with Leg Lifts	Begin with a 0:20 sec hold with both feet down, followed by 2 x 0:10 sec lift and holds for each foot, finishing with 0:30 sec hold with both feet down.
Prone Pass	15 repetitions

Conclusion

It is important to recognize the core as a very broad scope of muscles that work in union with one another to create and stabilize movement. Abdominal and lower back specific training is a necessity when designing programs for core development. However, it is vital to consider the entire anterior and posterior musculature of the upper torso through the hips in order to fully construct a core program. By considering and understanding the total scope of the core, acute or chronic injuries and performance limitations can be deterred or avoided completely.

Figures


Fig. 1a


Fig. 1b


Fig. 1c

Figures 1a – c. Plane Holds Elbows (with or without leg lift) —Timed and/or Repetition of leg lifts

Figures 2a – c. Plane Holds Hands (with or without leg lift)
—Timed and/ or Repetition of leg lifts

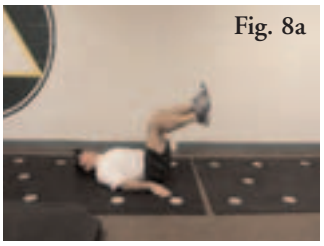
Figures 3a & b. Bench Bridge
—Timed and Repetition of arm lifts

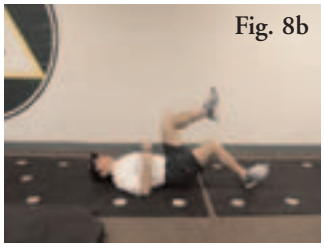
Figures 4a & b. Glute Hold (with or without leg lift)
—Timed and/or Repetition of leg lifts

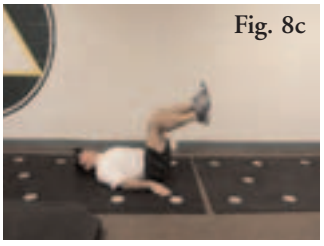
Figures 5a & b. Reverse Incline Plane (with or without leg lift)
—Timed and/or Repetition of leg lifts

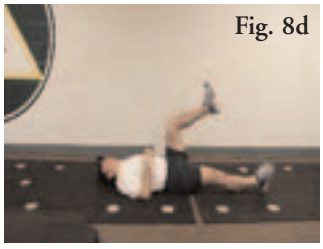
Figures 6a & b. Alternating Crunch Hold —Timed and Repetition

Figure 7. 45 Degree Hold—Timed









Figures 8a – d. Dead Bug (90 degrees or extended) —Timed or Repetition

Figures 9a – c. Prone Pass—Repetition

About the Author

Paul Goodman earned his BA and MS from the University of Wisconsin. He is currently the Head Strength and Conditioning Coach at the University of Vermont. Before taking this position he served as an assistant for the University of Wisconsin-Madison. Paul is also the Vermont State Director for the National Strength and Conditioning Association.