An athlete’s ability to handle their own body weight is foundational to competition-based actions. Thus, strength to weight ratio is a key correlate of improving sport performance. Instead of trying to gain additional strength, coaches and trainers can optimize strength already developed by recognizing that the human body functions systematically rather than in independent parts.

The entire body is connected by fascia, which allows muscle contractile forces to extend well beyond their respective insertion sites. This connection system allows for transfer of force over various body segments via anatomical force couples. Force couples help to optimize the force transfer and spare energy; when synched appropriately the system minimizes compensatory movements and prevents misdirected forces. There are four *sling systems* that function to stabilize the pelvis and allow for efficient energy transfer between local and global systems. Identifying and training the sling systems appropriately can help optimize strength to body weight ratio – this process is outlined later in the article.
Initiating Athletic Movement: Force Couples

Joint actions are not facilitated by a single muscle, as muscles are recruited in groups that counteract/balance one another to create fluid bodily movements. In the shoulder for example, movement of the humeral head is regulated by equal but opposite forces facilitated by the rotator cuff, deltoid, and scapular stabilizers depending on the movement. From a training perspective, force couples can be understood as a pair/group of muscles that act together on a joint to produce rotational forces (often pulling in opposite directions) that maintain optimized joint positioning and transfer of force through the associated body segment in the appropriate direction. The “synergist” muscles within a force couple often consist of prime mover-stabilizer or agonist-antagonist pairs. Common force couples include: the internal and external obliques for trunk rotation; the deltoid and rotator cuff for shoulder abduction; the upper and lower trapezius for scapular rotation. Functionally training force couples allows the body to improve its ability to manage conditions without undue resistance and energy wasting.

For efficient athletic movement, these systems must:

- Properly stabilize body segments to allow for effective force transfer (regional stabilization)
- Neutralize external forces to prevent movement compensations and faulty movement patterns
- Coordinately activate prime movers to maximize acceleration
- Synchronize local and global activation during sport actions to properly take advantage of forces created (e.g., trunk stability for bodily control during a maximal throw or jump)

Controlling Athletic Movement – Local Stabilizers, Global Stabilizers, Global Movers

Each joint/body segment has local and global systems of control. Local systems include muscles essential for localized joint stability and the maintenance of joint position during movement. Local stabilizers are often smaller and do not produce actual movement upon activation – such as the pelvic floor, transverse abdominis or multifidus. They prepare joints for oncoming force by acting in an anticipatory (bracing) manner; such as activation of the pelvic floor just before trunk stability is needed to quickly transfer force across the spine to a limb. This helps reduce the risk for injury to vital areas such as the lumbar discs. Global systems include muscles essential for regional stability as well as motion, and tend to work cooperatively with muscles from other systems to create connections across the body – such as the rectus abdominis or latissimus dorsi. Global stabilizers generate force to control the range of motion (ROM) at a segment and tend to contract eccentrically for deceleration and rotational control. Global mobilizers on the other hand, generate torque to produce actual movement, and therefore tend to contract concentrically. They also serve as shock absorbers during sport competition (e.g., pectorals while blocking in American football).
Inner and Outer Unit Synchronization

Part 1 – What is the inner unit

In most cases the trunk experiences the greatest risk for inefficiency due to the high number of joints. Lack of trunk efficiency reduces performance when force must manifest in the hands or feet; including most athletic actions (e.g., throwing a baseball, kicking a soccer ball). The local stabilizers of the trunk are often referred to as the inner unit. The inner unit provides stability by offsetting forces, not by simply creating rigid contractions. For this reason, closed-chain, dynamic lifts like hanging leg raises are used for core development over static activities such as planks. The “core” of stability is generally understood to include the following musculature which forms a protective “box” around the spine and internal organs:

- **Transverse abdominis (front of box)** – helps maintain intra-abdominal pressure to manage flexion and extension of the spine; also adds rigidity to the thoracolumbar fascia as a defensive response to prepare for external loads

- **Diaphragm (top of box)** – respiratory muscle that also serves as a stabilizer with multi-faceted control, contracts simultaneously with the transverse abdominis

- **Pelvic floor (bottom of box)** – stabilizes the spine and helps anchor the pelvic girdle in response to abdominal bracing; when weak or lacking endurance, the abdominals can impact pelvic movements and place undue strain on the spine and related stabilizers

- **Multifidus (back of box)** and internal obliques – connects the moving segments of the vertebrae to regulate spinal positioning and facilitates reactive stiffening to protect the discs and nearby tissues; contraction with the transverse abdominis also helps prevent undesirable changes in pelvic tilting

Part 2 – Training the sling systems

The outer unit, or sling systems, include global connectors that stabilize the spine and pelvis during movements involving the arms and legs such as running, climbing and stepping. These muscle systems work with the inner unit to transfer force across the hip and spine during sport actions. They are often coined “sling systems” as they include cooperative units of muscle and fascia designed to manage closed-chain actions by producing “slings” of force that transfer across body segments. As mentioned, these “force coupling systems” must stabilize body segments, neutralize external forces to prevent movement compensations, and promote coordinated activation of global movers to maximize acceleration.

The sling (force coupling) systems:

- **Anterior oblique sling** – Includes the external oblique, anterior abdominal fascia, and contralateral internal oblique, and hip adductors. This sling coordinates to create cross-stabilization for the pelvis and trunk during sagittal-plane locomotion such as walking or jogging. As the lower limb swings forward the contralateral arm creates counterbalance and the trunk is stabilized via a diagonal firing pattern and reactive myofascial stiffening. The obliques and abdominal fascia support the trunk and rotate the pelvis in concert with the hip adductors; allowing for an aligned heel strike under the hips while running. Athletes required to accelerate quickly must develop an efficient anterior oblique system.

- **Posterior oblique sling** – Includes the latissimus dorsi, thoracolumbar fascia, and gluteus maximus. It serves as the counter “cross-beam” to the anterior system via a functional connection between the gluteals and contralateral latissimus dorsi through the thoracolumbar fascia.

  During locomotion the gluteals fire for hip extension to facilitate propulsion, while the latissimus dorsi is activated for shoulder extension to provide counter-rotation (oppositional rotation force coupling).

- **Deep posterior longitudinal sling** – Includes the erector spinae, thoracolumbar fascia (deep), sacro-tuberosous ligament, biceps femoris and peroneals. This system is involved in forward acceleration, which is rooted in ground reaction force that must travel over
multiple joint segments. It connects the thoraco-
lumbar fascia and erector spinae to the bicep femoris,
and extends distally through the peroneals; using a
top-down approach for hip/knee stability. The system
is elongated, requiring synchronized action of multi-
ple segments: the erector spinae and thoracolumbar
fascia work together; the biceps femoris transfers
force through the sacrotuberous ligament; and dis-
tally the peroneals aid in ankle/foot stability.

• **Lateral sling** – Includes the gluteus minimus/medius,
tensor fascia latae, long and short ipsilateral ad-
ductors and contralateral quadratus lumборum (QL).
It functions to stabilize the hips when loaded and on
an anchored base for climbing and stepping. During
an action such as a step-up, the pelvis is stabilized by
the abductors/adductors of the plant leg while the
QL elevates the pelvis in conjunction with the rising
femur. When climbing, the downward leg anchors
the pelvis while the ascending hip/knee flex to estab-
lish a new anchor height.

Synchronized activation of the inner and outer units
during sport actions allow an athlete in motion to take
advantage of forces already created. In most cases, fit-
ness enthusiasts have developed adequate strength
through weight training but lack the ability to coordinate
force in functional environments. By practicing actions
that involve these systems to interact will lead to im-
provement in daily performance capabilities. The
following include exercise examples that emphasize
major force coupling systems.

### Anterior Sling Exercises

**Bulgarian with Single Arm Dumbbell Raise**

**Forward Lunge with Alternate Band Punch**
Posterior Oblique Sling Exercises

Reverse Lunge with Single-Arm Band Row

Reverse Lunge with Single-Arm Cable Row

Dumbbell Single-Leg RDL (Romanian Deadlift) to Overhead Swing
Lateral Sling Exercises

Lateral Step-up with Sand Bag Overs

Ballistic Side-Step Overs

Deep Posterior Longitudinal Sling Exercises

Smith Machine Leg Swings w/ Plantar Flexion

Power Skip Bounds