Dynamic Stability: Applying the Principles of Dynamic Neuromuscular Stabilization (DNS) to Strength & Conditioning

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What is Core Strength?
What is Core Strength?

How is “Core Strength” developed?
Over the past 20 years, our understanding of exactly what core strength is and how we are to train it has changed dramatically.

No longer can we act, program design and train athletes as if working the abs and the back sufficiently improves stabilization and function.

The modern strength coach will have a much more comprehensive understanding of function, movement and stability.

Leading the field, redefining our understanding of stability, movement and function are Pavel Kolar and the Prague School of Rehabilitation.

Trained by some of the greatest minds in rehabilitation, movement science, manual medicine, neurology, and kinesiology (Vaclav Vojta, Karel Lewitt, Vladimir Janda, Frantisek Vele), Prof. Kolar has developed an amazing comprehensive understanding of function, movement and stabilization.

His approach has profoundly influenced the medical and rehabilitation fields and is now being used by many of

Since 2000, Prof Kolar and the Prague School of Rehabilitation have been redefining our understanding of movement, stability and function. In 2007 Prof Kolar formally titled his approach “Dynamic Neuromuscular Stabilization”.

*Dynamic Neuromuscular Stabilization (DNS)* is a method/approach to assessment, rehabilitation and training that utilizes the scientific principles of developmental kinesiology to maximize results.

Based on the premise that normal children move with ideal movement patterns, the goal of DNS is to identify a patient’s (athlete’s) faulty movement/stabilization patterns and restore them back to their ideal state.
To accomplish this, Prof. Kolar created movement assessments and rehabilitation exercises based on movements and positions seen in early childhood development.

Utilization of these positions/movements is powerful because it incorporates stabilization of the entire system (instead of just the "core") and retrains.

It’s more than just “Core” Strength

Through their studies, the Prague school of Rehabilitation has discovered/demonstrated that stabilization and movement are global (systemic) events involving the entire body.

One cannot move without first stabilizing.

“Movement presupposes stability.”

To maximize our ability to train athletes, we must take
It's more than just “Core” Strength

The “core” is involved in this process, but only as one piece in a massive neuro-mechanical chain of events.

To improve an athlete’s ability to stabilize during sport (AKA ‘dynamic stability’) one must not only train the muscles of the trunk, but also the support

Quality & Efficiency

Training dynamic stability is less about maximizing the loads that the athlete can tolerate and more about training (restoring) the ideal stabilization/movement patterns.

Ideal movement patterns are more efficient and lead to increased performance and decreased risk of injury

Consequences of Inefficiency

If the athlete cannot stabilize with proper patterns, compensatory movement patterns dominate leading to...

Hyperactivity of larger muscles groups resulting in significant increase in joint forces
Increase risk of injury
Decreased force transfer through the joint
Decreased performance
Understanding and applying the principles of DNS greatly enhances a performance coach's ability to train their athletes for sport.

So how does the body stabilize itself for movement and how do we train it?

Anatomy of the Core

Diaphragm
- It has always been known that the diaphragm is important for proper respiration.
- Recently, research has shown that the diaphragm is also intimately involved with proper stabilization of the pelvis, ribcage and spine ("core")
- It attaches to the lower ribs and the spine at the thoracolumbar junction, separating the chest cavity from the abdominal cavity.
Abdominal Wall

- Comprised of the external obliques, internal obliques, the rectus abdominus and the transverse abdominus
- Attaches to the spine, pelvis, ribs and thoraco-lumbar fascia.
- Acts as a corset wrapping around the abdomen.
- Connects the ribcage to the pelvis.
Pelvic Floor

- Comprised of the levator ani, coccygeus and transverse perineal muscles, the pelvic floor acts as a miniature diaphragm on the bottom of the “core”.
- Attaches to the sacrum, both innominate and the femurs, greatly contributing to both hip and pelvic stability.

Lumbar Spine & Pelvis

Comprised of 24 vertebrae and 23 intervertebral discs, the spine sits atop the sacrum, which itself is part of both the spine and the pelvis.

The pelvis is composed of the sacrum and two innominate. These structures form three joints: 2 sacroliliac joints and a pubic symphysis.

The spine and the pelvis are rigid osseous structures to which the muscles of the “core” attach.
All of these structures form a cylinder

How is it generated?
Chemistry Review

Boyle’s Law
(Ideal Gas Law)

\[ V = \frac{k}{P} \]
Pressure and Volume are inversely related. It is because of this law that respiration, stabilization and movement are possible.

Respiration & Stability

Respiration and stability are inseparable. One cannot stabilize correctly without proper breathing mechanics. It is through respiration that continuous activation of the diaphragm, abdominal wall, and pelvic floor are maintained.

Respiration Review

During inspiration, the central tendon of the diaphragm drops, thereby increasing the volume of the thoracic cavity. This increase in volume drops the interpulmonary pressure below atmospheric pressure, driving air into the lungs.
Its all about Intra-Abdominal Pressure

- As the diaphragm contracts and the central tendon descends, the pelvic floor and the abdominal muscles eccentrically contract to regulate the volume within the abdominal cavity, which, in turn, controls the intra-abdominal pressure.
- If no additional stability is needed, the abdominal wall will expand to maintain the volume and therefore the pressure within the abdominal cavity.
- However, if additional stability is required, the abdominal wall will minimize its expansion, decreasing the volume of the abdominal cavity resulting in an increase in intra-abdominal pressure to better stabilize the system.

Intra-Abdominal Pressure & Stabilization

- As the intra-abdominal pressure rises, so does the force of the pressure pushing outward in all directions.
- This pressure is responsible for proper, efficient stabilization of the spine, which is the keystone for the entire body.
- This stability is paramount for the efficiency and stability of all motions, no matter how minute.

Activation of the postural stabilizers precedes ALL movements!

Abdominal Piston

- The diaphragm and abdominal muscles provide a piston-like action to regulate intra-abdominal pressure.
- This mechanism is crucial for spinal stability and overall body mechanics.
Postural stabilization is an ever-present task for the neuro-muscular system. One cannot wait until they consciously brace to be stable. It is for this reason that respiration is so vital to movement and function; it keeps the postural stabilizing system activated for each and every movement we make.

To Brace or not to brace...
Stewart McGill & the Czech's vs. Joseph Pilates & the Kiwi's

Abdominal Bracing
- Utilizes maximal eccentric activity to activate the entire stabilizing system.
- Facilitates co-contraction of the abdominal wall, pelvic floor and the diaphragm.
- Maximizes generation of intra-abdominal pressure.
- Natural

Abdominal 'Hollowing'
- Utilizes concentric contraction ("drawing in") to activate the abdominal wall.
- Activate the the abdominal wall without co-activation of the diaphragm.
- Activates the transvers abdominus, but does not increase intra-abdominal pressure to any significant level.
- Unnatural and not functional

Vs

To brace or not to brace....

Abdominal Bracing
Abdominal 'Hollowing'
Joint Centration

- **Definition:** Centration is the joint position utilizing the maximum available osseus contact for stability.
- Promotes synergy and co-activation of all muscles around the joint.

Proper centration results in...

- Efficient joint force loading
- Decreased joint forces required for execution of movement.
- Greater force transfer
- Increased performance
- Decreased risk of injury.
Proper stabilization entails maintaining joint centration throughout a movement.

Dynamic Stabilization Redefined: The ability to maintain proper joint centration of all motion segments throughout all movements.

The Great Misconception
The “core” is NOT the foundation for the body. It acts as more of an intersection of forces than a “foundation”.

As bipedal creatures, it is the lower extremity (controlled by the foot and the hip) that acts as the “foundation” for virtually all movements.

Efficient and effective stabilization requires good function and activity of the supporting segments (usually the lower extremity).
Femoroacetabular joint
AKA - the hips

Hips & Stability:
In a closed-chain system, the hips work to stabilize and centerate the pelvis & spine to allow for efficient and effective generation of intra-abdominal pressure.

The groin, glutes, hip-flexors, quads and hamstrings all work together to maintain proper hip function, stability and centration.

Hips & Stability
The hips also work synergistically with the foot/ankle to control pronation of the lower extremity so as to maintain a stable foundation for the core.

Any breakdown in this process causes instability of the pelvis, decenteration of the abdominal cylinder (core) resulting in instability of the entire system.
The Importance of the Foot

- Proper arch (foot) function is required for maximal stability of the entire system.
  - Works with the hip to control position of the knee.
  - Allows activation of the glutes for proper hip/pelvis stabilization.
  - Maintains proper joint positioning for efficient force transfer from the legs into the pelvis, trunk and upper extremity.
- Proper activation of the foot involves loading the foot as a tripod (not just the heel).
- Loading the "tripod" activates the entire stabilization system.
- Maintaining an active tripod through the entire lift is paramount to effective execution.

However...

It is the “core” who stabilizes the hips for open-chain function.

Remember: the core would not be able to stabilize the hips for open-chain function without itself first being stabilized.

Hips in Function
The Shoulder

Dynamic Stability of the Shoulder

- Shoulder complex is comprised of 4 joints:
  - Acromioclavicular, sternoclavicular, glenohumoral and scapulothoracic (not really a joint)
- Has an incredibly large range of motion (3 degrees of freedom); and therefore, requires immense activity of the stabilizing system to function correctly.

Dynamic Stability of the Shoulder

Conceptually, the shoulder complex can be broken up into 2 joints: scapulothoracic and glenohumeral.

Movement of the scapulothoracic joint is the summation of motions performed at the sternoclavicular and acromioclavicular joints.
**Dynamic Stability of the Shoulder**

- It is because of the scapulothoracic joint that the shoulder complex is able to maintain stability through such a massive range of motion.
- Attaching to the scapula are the rotator cuff muscles which blend with the glenomumoral capsule enabling them to keep the humoral head centered within the glenoid fossa.

The body utilizes motion of the scapula to maximize the shoulder complex's range of motion, while maintaining centration of the glenohumoral joint. Stabilization of the scapula, therefore, is paramount for proper shoulder (and upper extremity) function.

To accomplish this daunting task, 17 muscles attaching to the scapula work together to

**Dynamic Stability of the Shoulder**

- Activation of the diaphragm and abdominal wall creates a "punctum fixum" for the scapular stabilizers.
- Any inhibition the abdominal wall &/or diaphragm results in insufficient scapular stabilization causing instability of the scapulae and the entire shoulder complex.
Dynamic Stability of the Shoulder

- Scapular instability prevents the body from keeping the glenohumeral joint centered, overloading the rotator cuff.
- This leads to over-activity of the larger muscles of the shoulder (pecs, traps, etc.) resulting in improper joint motion, pain, injury and decreased performance.

Force Transfer

- The abdominal wall and the core are responsible for transferring energy traveling from the lower extremity into and through the upper extremity.
- Remember, increased intra-abdominal pressure eccentrically activates the abdominal wall. The greater the tension in the abdominal wall, the greater its rigidity. Increased rigidity results in more efficient energy (force).
Transfer of Forces

Also, the more stable the core, the better the body is able to maintain centration of the peripheral joints. Maintenance of joint centration increases performance and protects the joints.

A breakdown in this process leads to compensatory motion, inefficient energy transfer resulting in decreased performance and increased risk for injury.

SO WHAT EFFECT DOES THIS HAVE ON STRENGTH TRAINING?

How can we apply these principles to program design?
Rules to follow:
• Keep the core engaged.
• Pay attention to the supporting structures.
• Incorporate global patterns whenever possible
• Keep the joints Centrated!
  – Keep the foot loaded properly.
  – Keep the knees slightly out.
  – Keep the scapula depressed

Train proper patterns not compensatory ones!!!!

Back Squat

- Knees in a neutral position
  - Lumbar spine arched

The erectors are on, but postural stabilizers are not engaged.

- Hips Centrated: knees abducted/tibia externally rotated.
- Lumbar spine neutral
- Actively bracing into abdomen

Postural stabilizers engaged.

Dispelling Myths:

• End-range lumbar extension is NOT the proper (centrated) position for the lumbar spine.
  – Excessive lumbar extension antverts the pelvis, forcing the diaphragm and pelvic floor out of position, inhibiting the body’s ability to generate maximal IAP.
  – Lumbar extension is a protective position when forces required to execute the movement exceed the body’s ability to maintain a centrated position.
  – Occurs when maximal IAP generation is insufficient
Dispelling Myths

• Utilizing lumbar extension simultaneously inhibits the diaphragm and abdominal wall and over-activates the erector spinae.
• Uses excessive compression to stabilize the spine, greatly increasing internal forces required to execute all movements.

Centration of the Lumbar Spine

Strait Bar Lunge

• Lumbar spine in neutral position to keep the pelvis and diaphragm centrated for maximal generation of IAP
• Tripod loaded (foot centrated)
• Hip slightly abducted (knee outside big toe)

Remember: maintaining centration of the supporting segments is a prerequisite for proper activation of the deep stabilizing system.
Bench Press (traditional)

- Excessive arch at the TL junction decentrates the spine and pelvis resulting in poor activation of the deep stabilizing system.
- Inhibits many of the scapular stabilizers necessary for execution of the movement.
- The passive stability of this position enables the athlete to execute this motion without activation of the deep stabilizing system.

Bench Press (4.5 month position)

- Diaphragm and pelvic floor remain parallel for optimal generation of IAP.
- Activates the deep stabilizing system.
- Enables the athlete to maintain scapular stability and centration of all the joints.

S.A. Dumb Bell Row (traditional)

- Center of Mass is close to the supporting segments, decreasing the demand on the deep stabilizing system.
- Majority of the weight is passively loaded onto the right leg.
- The larger trunk muscles rotate the trunk, assisting the smaller muscles of the arm, bringing the COM even closer to the supporting segments.
**S.A. Dumb Bell Row**
(Bear Position - 9 months)

- Trains the support function of the opposite arm & legs.
- COM farther away from the supporting structures, putting greater demand on the deep stabilizing system.
- Postural stabilizers have to maintain trunk position.
- Activates the entire body (elicits a global pattern).

**Dumb Bell Pull-Over (traditional) Dumb Bell Pull-Over (4.5 months)**

- Passively loading into the bench.
- Decentration of the diaphragm and pelvis.
- Inhibition of the scapular stabilizers.
- Actively bracing.
- Good centration of the spine and pelvis.
- Good circumphrential activation of the abdominal piston.

**DB Front Raise (traditional)**

- COM is directly over the BOS and, therefore, does not engage the deep stabilizing system to any significant degree.
- Isolates motion at one joint (non-functional).
- No global pattern is initiated.
**DB Front Raise (Bear Position)**

- **Trains the support function of both the upper and lower extremities.**
- **Puts a greater demand on the core and the deep stabilizing system.**
- **Activates a global pattern.**

Remember: training the global patterns improves the body's ability to stabilize, move, function and perform.

**Single Arm DB Press (Traditional)**

- **Minimal engagement of the lower extremity stabilizers.**
- **Bell up KB challenges the proprioceptive system increasing activity of the deep stabilizing system.**
- **Half-kneeling position better engages the hip stabilizers, increasing the activity of the deep stabilizing system.**

**Single Arm DB Press (Half-Kneeling/9 month)**

- **Good co-activation of the spinal flexors and extensors.**
- **Maintains activation of the scapular stabilizers.**
- **Trains proper movement patterns.**

**Push-up (Traditional)**

- **Decentration of the spine and pelvis, resulting in hyperactivity of the erector spinae and inhibition of the diaphragm and abdominal wall.**
- **Trains compensatory movement patterns.**

**Push-up (Extended Bear)**

- **Good co-activation of the spinal flexors and extensors.**
- **Maintains activation of the scapular stabilizers.**
- **Trains proper movement patterns.**
• Over-activation of the rectus abdominus resulting in poor co-activation of the spine and pelvic stabilizers.
• Decentrates the spine/ pelvis
• Significantly increases intradiscal pressure.
• Maintains joint centration to optimize IAP generation.
• Phenomenal position in which to practice diaphragmatic breathing/bracing.

We don’t need to do traditional “core” work if we are consistently training the deep stabilizing system in each of the exercises we perform.

We must focus on improving the athlete’s ability to maintain joint centration during sport.

Remember both the open-chain (phasic/movement) and closed-chain (support) functions of each of the muscles and joints.

Remember that all movements/exercises have the potential to train the stabilization system.

Things to Remember...
• Postural stabilization is a systemic event, involving every joint.
• Any breakdown in postural stability results in instability of the entire system.
• An inability to maintain centration forces compensatory movement patterns to dominate.
• Compensatory activation of muscles results in:
  – Improper joint motion
  – Inefficient force transfer
  – Increased internal forces required to execute a movement
  – Decreased performance
  – Higher propensity for injury
Thank you for your time.

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NNSA 2013 Annual National Conference
JULY 10 - 12, 2013 | Las Vegas, NV