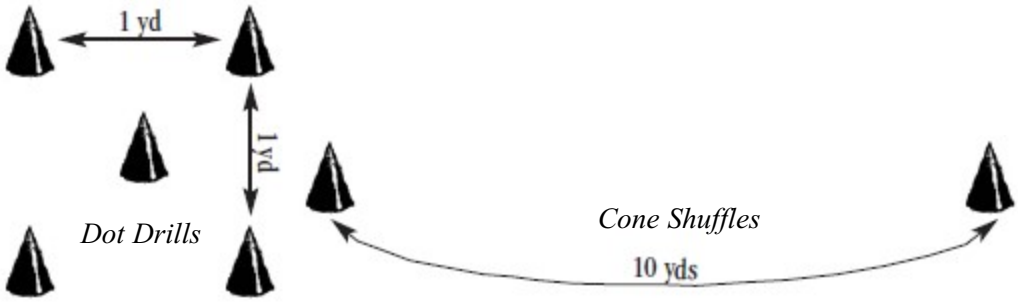
moving forward, backpedaling and laterally.

12. Cone Shuffles: place two cones ten yards apart, two servers are in front of each cone. Keeper moves laterally using a variety of footwork patterns between cone forming an arc about one yard in distance. This is similar to moving from post to post at the goal. Server tosses the ball as the keeper reaches each cone performing a save. o



Bridging the Gap-Soccer

KEEP BACK PAIN AWAY – ISOMETRIC EXERCISES CAN "PREHAB" THE TRUNK

Jennifer Novak, MS, CSCS, CEO, PEAK Symmetry Performance Strategies

Jennifer Novak, MS, CSCS is the CEO of PEAK Symmetry Performance Strategies in Atlanta, Georgia. Jennifer has a master's degree in kinesiology, a graduate certificate in orthopedic injury and post-rehabilitation programming, and is a certified strength and conditioning specialist through the NSCA, where she currently serves as a member of her state's Board of Advisors. She has taught at Emory University's department of Health and Physical Education, has been interviewed by local sports radio programs as a sports injury expert, and has presented at national conferences. By combining expertise in exercise science and motor control/functional neurology, Jennifer provides highly individualized pathways to improve clients' training response and overall performance. Perhaps that's why her nickname in the industry is "The Muscle Detail Shop".


Jennifer Novak

The first part of this article presents a medical/exercise science prospective of low back pain and prevention strategy. The second part is a prehab prevention conditioning program. We encourage the soccer/strength and conditioning coach to provide this information to their sports medicine professional to create discussion and strengthen their working relationship. ***- Ken Kontor, Publisher***

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LOWER BACK PAIN (lbp) in the athlete is more common than one might think. Depending on the sport and positions within sports, current estimates of lbp at some point among athletes ranges from 18-65%, much higher than incidences of pain in either the thoracic (6% average) or cervical (4% average) ranges (Trompeter, Felt, & Platen, 2017). Over the course of an athlete's lifetime, one study proposed prevalence of lbp (at some point in an athlete's career) as much as 94%, with males reporting a higher incidence than females (Trompeter et.al., 2017)! In adult athletes, pain may typically be attributed to either muscular or ligamentous strain or a lumbar disc issue, or what's known as non-specific low back pain (Trompeter et.al., 2017). Youth athletes may be more prone to back pain due to a spondylolisthesis, or anterior slippage of one vertebra over another – either by congenital defect or acquired.

However, it is the muscular system that comprises the **ACTIVE** restraints and allowances to proper motion, and therefore, supports and guards the more passive structures like the ligaments, bones, and discs of the lower back region. While the use of resistance training to improve muscular strength and support of the spine has been well-documented, here may be a point where training intensity and volume, combined with the repetitive motions of certain sports and/or sport positions, may place one at risk for developing this ubiquitous condition. Knowing this, current research would also suggest that improving muscular function through on-demand contractile capability, with mobility throughout the sports ranges of motion and muscular stamina would be of utmost importance in the prevention of low back pain that would hinder performance.

ISOMETRIC EXERCISE has a rich history with athletes in terms of improving strength, hypertrophy, and power from the likes of Charles Atlas and Arnold Swarzenegger (bodybuilders), Bruce Lee (martial artist), and Alexander Zass (strongman). Lately, isometric exercise is trending as a safe and versatile means to promote preventative strength (Ryu, Park, Park, & Park, 2015), stamina (Ryu, et.al., 2015), firing rate (Del Balso & Cafarelli, 2006), and tendon stiffness (Blackburn & Norcross, 2014), among other benefits, depending on targeted design and strategic application.

THE SAFETY and VERSATILITY of isometric exercise provides endless combinations of exercise design because the joints remain stable during the contractions and the exercise can be adapted to numerous joint angles/positions. Changes to variables like intensity, volume, duration and/or velocity of contraction, direction of force, involving single or multiple joints, executing them unilaterally or bilaterally, changing the work:rest ratio, and more, can provide nearly endless manipulations to reach preventative and performance goals. While they're not intended to REPLACE dynamic exercise, isometrics can go a long way in improving **MUSCULAR RESPONSIVENESS** at both central (brain) and peripheral (neuromuscular junction) locations (Mafiuletti & Martin, 2001; Del Balso & Cafarelli, 2015).

ISOMETRICS = PVMC

For the purposes of this article, we will rename the targeted isometrics **POSITIONAL, VOLITIONAL MOTOR CONTROL** exercises, or **PVMCs**. Why? Because one of the first reasons for using an isometric is to improve motor control by stimulating multiple brain areas concerned with the planning, coordination, and execution of both training and sport movement. Passive interventions in which we engage to change tightness in a muscle or muscle group will only stimulate one brain area, the somatosensory cortex within the parietal lobe (contralateral to the side we address). **PVMC** exercises create a bridge that takes the somatosensory input and with active participation of the athlete, reaches the other parts of the brain within the timeframe that stretch reflexes, joint mechanoreceptors, and proprioceptors are going to provide different input to the same area, but will also reach places like the following to assimilate and utilize the new information to assist in motor control and learning. For single joint, unilateral PVMCs, these important brain areas are stimulated:

1. MOTOR OUTPUT (contralateral primary motor cortex)
2. COMPLEX MOVEMENT PLANNING (SMA)
3. PLANNING/EXECUTION (Putamen)
4. REWARD (Pallidum)
5. MOTOR TONE (Cingulate cortex)
6. MOVEMENT COORDINATION/EXECUTION (ipsilateral cerebellum) and
7. PROCESSING SENSORY INPUT (Ipsilateral parietal lobe/somatosensory cortex)

By changing to a multi-joint PVMC, you'll also be adding
1. COMPLEX MOVEMENT AND MULTI-JOINT COORDINATION (premotor cortex) and
2. BODY MAPPING/COMPLEX SPATIAL AWARENESS (somatosensory association cortex)

To the motor control and task learning list. This broad range of CNS stimulation and utilization is why **PVMC** exercises inserted into a training program may be of great importance to overall performance.

Referring back to safety and versatility, the ranges of the aforementioned variables will be confined to promote prehabilitative benefits, which is designed to make one **LESS VULNERABLE** to low back injuries common to sport by promoting core stiffness (Lee & McGill, 2015) and muscle activation (Mafiuletti & Martin, 2001; Del Balso & Cafarelli, 2015). The exercises are for the most part universal in ability and effect, but of course, let pain be your guide and modify any of the exercises to pain-free range of motion or force tolerance levels.

THE FOLLOWING EXERCISES can be executed as part of the strength training regimen, but may most comfortably fit into a mobility session, or as part of a warm-up. Remember, these particular intensities and volumes listed are designed to be **PREVENTATIVE**, protecting the core from potential episodes of lbp.

EXERCISES 1 AND 2 (ANCHORING ANTERIOR AND POSTERIOR CHAIN)

- Foundational multi-joint core exercises
- Research backing up the benefits
- Completed before any or each training session, time permitting, or at least twice per week
- PVMC exercises offer both acute and chronic effects, so completed regularly, during any season, can be a good thing

EXERCISES 3A, 3B (Ready Position Power)

- 3A can be utilized in a "ballistic" fashion for training (or retraining) the synergies between hip and trunk flexion (moving in and out of ready stance)
- Moving quickly into the position, holding, and then quickly releasing should support this combo
- Contralateral version (3B) is utilized if training trunk rotation with kicking mechanics is deemed appropriate for that athlete
- Either or both can be used if mobility or coordination asymmetries are discovered in movement assessment analyses (FMS, DWMA, etc.)

EXERCISE 4 (Reinforcing Contralateral trunk pattern)

- To be used if movement analysis reveals gait-related trunk asymmetries
- Place within warm-up or mobility session
- Cueing to use trunk/core as opposed to extremities important

EXERCISE 5 (Trunk Rotation)

- To be used as warm-up or corrective
- Contralateral trunk rotation important for power in kicking leg
- If needed as analysis dictates

EXERCISE 6 (IMTP)

- To be used after any form of passive intervention changing joint ROM
- NOT a max lift – about 50% effort
- Enough to give every joint above and below area of passive intervention opportunity to provide new sensory input to the CNS for utilizing before loading in training

1. ANCHORING THE ANTERIOR CHAIN

EQUIPMENT:

- Mat
- Training partner
- Possibly small ball or yoga block (see below)

WHY:

This exercise was used as part of a study in a Korean University to find better ways of engaging the **TRANSVERSUS ABDOMINIS** muscle, a lower abdominal muscle that is key in supporting the lumbo-pelvic complex and stabilizing the lumbar spine.

HOW TO EXECUTE:

- Lie supine, arms by the sides of the body, dorsiflexing the feet.
- Have a partner hold onto your feet, and with the chin tucked, lift upwards into a small core lift (up to the shoulder blades), reaching fingertips toward your partner and breathing, drawing the navel up and in toward the spine.
- Simultaneously pull the feet into further dorsiflexion (toes toward nose), until you feel the abdominal muscles below the navel engaging. Hold for 10 seconds, rest for 10 seconds, and repeat 4-5 times.

TRAINING TIP:

If your athlete is **QUAD DOMINANT**, they may not initially be able to feel lower abdominals engaging in this exercise. Have them squeeze a lacrosse ball, or small side of a yoga block, between their thighs to take some of the effort away from rectus femoris, and they should start to feel the transversus engaging.

BONUS PREVENTION FOR COMMON SOCCER INJURY: HAMSTRING STRAINS

This **PVMC** has been shown to not only improve activation of the T**RANSVERSUS ABDOMINIS** muscle – a key muscle for providing support to the lumbar spine – but can also improve performance of the **ACTIVE STRAIGHT LEG RAISE**, used frequently to assess hamstring mobility. Wan et.al. (2017) found that hamstring mobility is correlated with incidence of hamstring strain during sprinting movements. In soccer, hamstring strains have been noted to comprise anywhere from 11-16% of all lower body injuries; therefore, creating a stable and strong core may also help attenuate the strain placed on the hamstring, shown to be at greatest risk in moving from late swing phase (eccentric) into foot strike (concentric) (Turner, et.al., 2014).

2. SECURING THE POSTERIOR CHAIN, STABILIZING THE SI JOINT

EQUIPMENT:

- Glute-ham apparatus or
- Secure, low-positioned bar or
- Trainers hands for supporting lower legs

WHY:

By combining the lateral hamstrings with gluteus maximus activation on the same side, and multifidus on the opposite side, a sturdy force vector is achieved for anchoring the sacrum between the ilia (hip bones) on both sides, thereby preventing any aberrant shear forces on the L5-S1 junction (between the lower back and sacrum).

HOW TO EXECUTE:

- Can be done either on a glute-ham apparatus or on the floor (shown).
- The athlete's thighs are slightly externally rotated to bias for the lateral hamstring group, also known as biceps femoris.
- Lower legs hooked under the rollers on the glute-ham machine or other stable bar with enough room to create about 130 degrees of knee flexion (or can be done manually with a partner cupping the heels or ankles)
- Draw the weight of the navel off the floor (or stabilize on glute-ham), and lift into a small amount of extension through the spine, arms reaching toward the feet to encourage scapular stability
- Breathe through the exercise, holding 10 seconds, resting 10 seconds, and repeating 4-5 times.

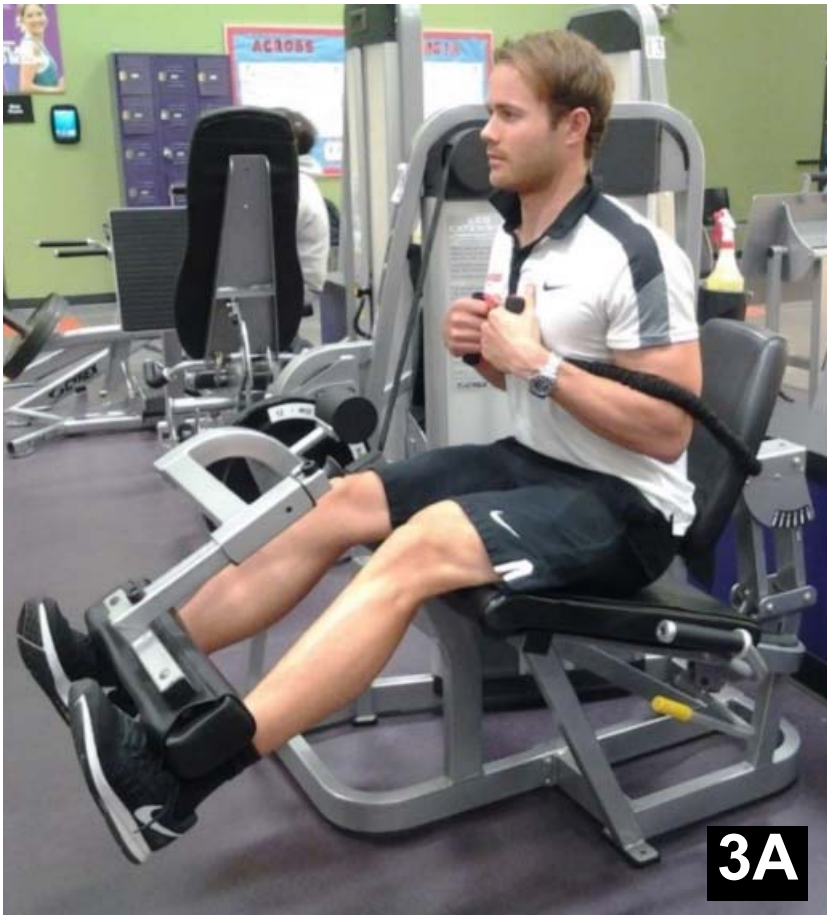
TRAINING TIP:

If using and glute-ham apparatus and the athlete feels discomfort in lower back or SI area, move them to the floor or a table to provide a greater base of support

3. (A and B) READY POSITION POWER

EQUIPMENT:

- Leg extension apparatus
- Resistance band



WHY:

By adapting a simple leg extension machine for specific core usage, this PVMC is helpful for creating a synergy between hip flexion and trunk flexion, particularly the lower abdominals that surround the hip complex and provide anterior lumbar stability.

In both photos:

HOW TO EXECUTE:

- Move the cam for the leg bar as far out as it can go (typically just shy of terminal knee extension)

- Place the pin in the bottom plate so that the stack doesn't move
- Hook a resistance band behind the back of the seat, and create tension as the athlete "hugs" it around the front of his/her chest

3A:

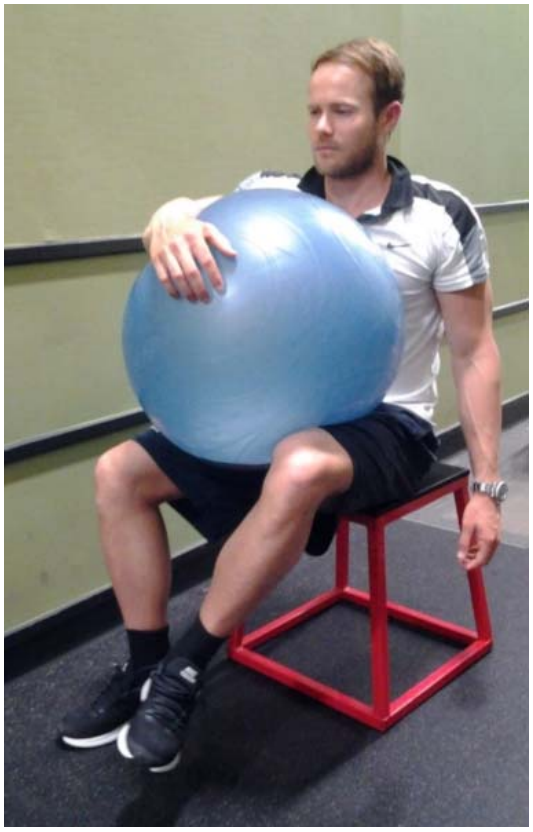
- Use quads and hip flexors to press into the leg pad
- Simultaneously have them hinge forward with the trunk as the band provides its own resistance vector.
- Breathing through this, hold a minimum of 15 seconds, up to 25, resting about half the amount of time spent resisting the two directions
- Repeat 3-5 times.

3B:

- Trunk is rotated toward the opposite externally-rotated thigh, and resistance is applied both ways
- This may be more challenging to hold, aim for 10 seconds into the resistance, 10 seconds rest
- Repeating 3-5 times.

TRAINING TIP:

With a little creativity, this exercise can also be replicated on a glute-ham apparatus, with the athlete seated and the feet under the upper pad, using a monster band that is either manually held behind them by a coach or training partner, or anchored at an appropriate height somewhere else to create the resistance for the trunk. The first photo is bilaterally executed equally, while the second photo offers an alternative for gait related opposing upper and lower body resistance (as may be helpful in kicking motions).



4. FURTHER REINFORCING GAIT-RELATED TRUNK MOTION

EQUIPMENT:

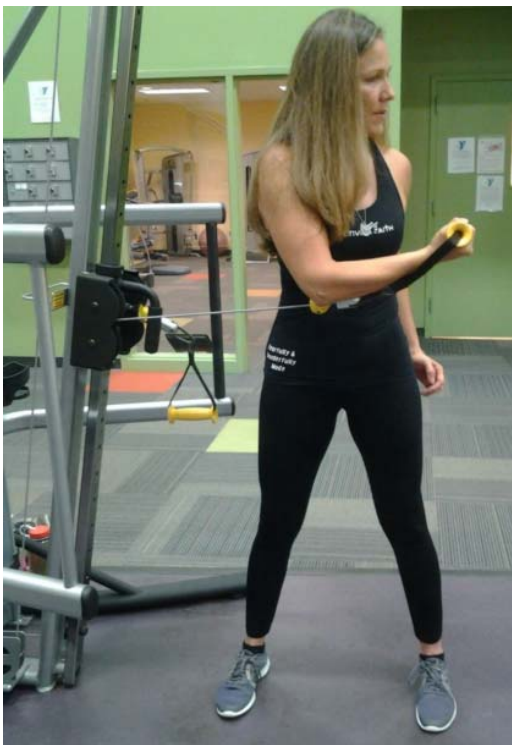
- Bench, jump box, or other place to sit
- Stability ball appropriately sized for athlete

WHY:

To reinforce gait related trunk motion. While it looks as if this athlete is using his opposing arm and leg to squeeze this stability ball, the exercise is called the TRUNK ball hug.

HOW TO EXECUTE:

- Slightly externally rotated hip and flexed arm
- Use the ball as a tactile cue for the trunk and have them squeeze the ball as if the arm and leg were not available, working through initial trunk rotation/flexion with hip approximation
- Squeezes can be done 5 seconds pressing diagonally in, 5 seconds rest, 4-5 reps each side.



TRAINING TIP:

This exercise can be done bilaterally if needed, or one sided, based on repetitive movement of the given position or sport dictates.

5. TRUNK ROTATION

EQUIPMENT:

- Adjustable cable machine with handle or
- Resistance band with stable place to anchor

WHY:

Many athletes have some level of trunk rotation involved in sport movement, and the same holds true in soccer. Providing a PVMC exercise that includes trunk rotation can help prime that movement pump.

HOW TO EXECUTE:

- The athlete is holds a cable (with about 30 lbs resistance loaded on it) close to the body at waist height, palm supinated
- Utilize trunk rotation to push the resistance away from the machine
- Keep pelvis neutral
- Hold 10 sec, rest 10 sec, repeat 4-5 times

TRAINING TIP:

This can be executed sitting as well if needed but keeping the hips parallel with the cable will help emphasize trunk rotation. Hold the end comfortable range of

trunk rotation with a neutral hip. If the athlete is ready, these can be used with graded amount of trunk rotation, starting small and increasing as the athlete is able to keep the pelvis neutral and there is no pain.

6. GIVE EVERY JOINT A VOICE BONUS MULTI-JOINT PVMC

EQUIPMENT:

- Squat rack
- Olympic bar
- Enough plates to hold bar stationary

WHY:

Whenever we stretch, or foam roll, or get a deep tissue massage, there's a need to get all the muscles and joints reintegrated into the idea of moving again. If a passive intervention is used to improve range of motion, the sensory reporting system, both in joint mechanics and muscular excitatory/inhibitory mechanisms, has changed, but only one area of the brain (the somatosensory cortex, mentioned earlier) is hearing this information (Mima, et.al., 1999). For this reason, I have a go-to exercise that most, if not all, of my athletes are given after any such passive intervention to help integrate new information into the motor planning fold.

By utilizing an isometric mid-thigh pull (at about 50% of what you feel you "could" do), the ankle, knee, hip, spine, and arm areas are given an opportunity to send new sensory information to the brain for assessing and eventually planning, coordinating, and executing movement using the new info. Earlier in this article, the number of brain areas stimulated with isometrics was listed, including the motor and premotor cortices, areas concerning balance and coordination, and areas concerned with body mapping and complex spatial awareness are also getting a workout (Yoon, et.al., 2014; Albein, et.al., 2013). The CNS needs this kind of input in a safe environment (motor control and learning calls that "constraints") to begin utilizing changes done peripherally via feedback and feedforward communication loops.

HOW TO EXECUTE:

- Feet shoulder's width apart, chest, toes, and knees pointed forward
- Hinge at the hip, gripping the bar at shoulder's width (both sides of this machine are loaded as heavy as possible) and pull as if finishing the concentric phase of a deadlift.
- Core engaged
- Use approximately 50% of a max effort
- Breathe through the exercise, holding for at least 15 seconds, resting the same amount, and repeating 3-5 times

TRAINING TIP:

Again, this is not designed to be a "max" effort, but working at about 50% effort, the IMTP can be used as a "reporting tool" to allow every joint to report new positional and stretch/deformation information to the CNS for planning and coordinating movement with new joint mechanics and muscle function.

PUTTING IT ALL TOGETHER

By understanding force application and being aware of the form and force tolerance of the body in front of you, the **SAFETY** and **VERSATILITY** of **PVMC** exercises can be utilized to promote better motor control through

1. Active client engagement
2. Stimulation of multiple brain areas
3. Reinforcing muscle synergies
4. Improving muscular responsiveness and resilience

****IF YOU DO ACQUIRE LOW BACK PAIN, THE TOOLS ARE ALSO RIGHT HERE***

Find your athlete suffering a bout of low back pain? Of course, seek a medical professional to rule out any pathologies needing immediate attention, but the good news is that the first two PVMCs in this article (anchoring/securing the anterior and posterior chains) have been used in studies to reduce pain, increase muscle activation of key core muscles, and decrease what's called antici-

patory postural adjustment delay (a delay in the reflexive muscular activity of deep spinal muscles in anticipation of extremity movement). The efforts aren't maximal either; the studies report that acutely, pain should be reduced and reflexive spinal activation should improve; motor control-related autonomous activation is improved centrally and peripherally within 3 weeks (Massé-Alarie, et.al., 2016). In fact, applying these two isometrics for 5 seconds work: 5 seconds rest, repeating 5 times 3x per week in addition to reduced training load can have quite positive outcomes. That's not a lot of time to dedicate to better low back function! O

More Information Please! Contact PEAK Symmetry Performance Strategies at **www.symmetryperformance.com** or Jennifer directly at **jennifer@symmetryperformance.com**

Net Link: References:

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