# DOWNLOAD PDF GLOBAL MUSCLE STABILIZATION TRAINING

## Chapter 1 : Global Stabilizers for the Lower Back

*Training movement system muscles before training muscles of global and local stabilization systems would not make sense from structural and biomechanical standpoint. Doing so would be analogous to building a house with no foundaiton.*

Tuesday, August 2, Dr. Weakness or lack of sufficient co-ordination in core musculature can lead to less efficient movements, compensatory movement patterns, strain and overuse and injury. The program starts with restoration of normal muscle length and mobility to correct any muscle imbalances. Next, fundamental lumbopelvic stability exercises are introduced, teaching the patient to activate the deeper core musculature. When this has been mastered, advanced lumbo-pelvic stability exercises using the Physioball are added for greater challenge. As the patient makes the transition to the standing position, sensory-motor training is used to stimulate the sub-cortex and provide a basis for more advanced functional movement exercises, which promote balance, co-ordination, precision, and skill acquisition. Concept of Core Stability The core musculature is composed of 29 pairs of muscles that support the lumbopelvic-hip complex. These muscles help to stabilize the spine, pelvis, and kinetic chain during functional movements. When the system works efficiently, the result is appropriate distribution of forces; optimal control and efficiency of movement; adequate absorption of ground-impact forces; and an absence of excessive compressive, translation, or shearing forces on the joints of the kinetic chain. The term core has been used to refer to the trunk or more specifically the lumbopelvic region of the body Bergmark, A,. M et al, Panjabi, M. The stability ofthe lumbopelvic region is crucial to provide a foundation for movement of the upper and lower extremities, to support loads, and to protect the spinal cord and nerve roots Panjabi, M. Panjabi defined core stability as "the capacity of the stabilizing system to maintain the intervertebral neutral zones within physiological limits". The stabilizing system has been divided into 3 distinct subsystems: The passive subsystem consists of the spinal ligaments and facet articulations between adjacent vertebrae. The passive subsystem allows the lumbar spine to support a limited load approximately 10 kg that is far less than body mass. Therefore, the active muscle subsystem is necessary to allow support of body mass plus additional loads associated with resistance exercises and dynamic activities Mcgill, S. Bergmark divided the active muscle subsystem into "global" and "local" groups, based on their primary roles in stabilizing the core. The global group consists of the large, superficial muscles that transfer force between the thoracic cage and pelvis and act to increase intraabdominal pressure e. Conversely, the local group consists of the small, deep muscles that control intersegmental motion between adjacent vertebrae e. The core muscles can be likened to guy wires, with tension being controlled by the neural subsystem. As tension increases within these muscles, compressive forces increase between the lumbar vertebrae; this stiffens the lumbar spine to enhance stability Mcgill, S. The neural subsystem has the complex task of continuously monitoring and adjusting muscle forces based on feedback provided by muscles spindles, Golgi tendon organs, and spinal ligaments. The requirements for stability can change instantaneously, based on postural adjustments or external loads accepted by the body. The neural subsystem must work concomitantly to ensure sufficient stability but also allow for desired joint movements to occur. A key muscle that works with the neural subsystem to ensure sufficient stability is the transversis abdominis. Other studies have demonstrated that the transversis abdominis was the first muscle activated during unexpected and self-loading ofthe trunk Cresswell, Oddsson et al and during upper and lower extremity movements, regardless of the direction of movement. Hodges and Richardson proposed a feed-forward mechanism associated with function ofthe transversis abdominis. The neural subsystem utilizes feedback from previous movement patterns to coordinate and preactivate this muscle in preparation for postural adjustments or the acceptance of external loads. In another study, Hodges and Richardson demonstrated delayed activation of the transversis abdominis in subjects with low back pain, suggestive of neural control deficits. Some practitioners mistakenly believe that the smaller local muscles are involved primarily with core stability, whereas the larger global muscles are involved primarily with force production Johnson, P, Verstegen, M. This mistaken belief has prompted ineffective training strategies designed to train the local and global muscle groups separately in nonfunctional positions. For example, the abdominal draw-in maneuver, typically performed in the quadruped or supine body position, has been widely promoted to train the stabilizing function of the transverses abdominis Johnson, P, Verstegen, M. For example, local muscles, such as the multifidus and rotators, contain high densities of muscle spindles. Therefore, these muscles function as kinesiological monitors that provide the neural subsystem with proprioceptive feedback to facilitate coactivation of the global muscles to meet stability requirements Nitz, A. McGill stated, "The relative contributions of each muscle continually changes throughout a task, such that discussion of the most important stabilizing muscle is restricted to a transient instant in time". Core stability is a dynamic concept that continually changes to meet postural adjustments or external loads accepted by the body. This suggests that to increase core stability, exercises must be performed that simulate the movement patterns of a given activity. The co-contraction of the deeper-layer transverse abdominus and multifidi muscle groups occurs prior to any movement of the limbs, and believe that this neuromuscular pre-activation is critical in stabilising the spine prior to any movement. The core program Stability work should be started only after the patient has achieved good mobility, as adequate muscle length and extensibility are crucial to proper joint function and efficiency. Although beyond the scope of this article, a thorough evaluation of the muscular system should include an assessment of the muscles for over-activity, shortening, weakness, inhibition, and quality of motion. This is best accomplished by a skilled physician or therapist using muscle-length tests, strength tests, and tests for the efficiency of basic movement patterns and neuromuscular control. Preliminary stretches for shortened muscles should include proprioceptive neuromuscular facilitation PNF type or contract-relax stretches that strive for isometric contraction, followed by end-range stretching. These are effective techniques for maintaining muscle length and joint mobility. Myofascial Release Techniques when used in conjunction with stretching techniques, have shown great promise in restoring muscle length and soft-tissue extensibility. Patients can be taught to do their own self-mobilization with use of a foam roll. Specific exercises for the patient should progress from mobility to stability, to reflexive motor patterning, to acquiring the skills of fundamental movement patterns, and finally, to progressive strengthening. For example, patients with iliotibial band syndrome often have weakness in their hip abductors that predisposes them to increased stress on the iliotibial bands. Thus, a preventative training program for patients with this syndrome must target the hip abductors, particularly the posterior aspect of the gluteus medius that assists external rotation or in decelerating internal rotation of the hip. Other muscles that prove weak or inhibited on evaluation should also be strengthened on a case-by-case basis. Fundamental lumbo-pelvic stability The purpose of basic core stabilization exercises is not only to increase stability, but more importantly it is to gain co-ordination and timing of the deep abdominal-wall musculature. It is extremely important to do these basic exercises correctly, as they are the foundation of all other core exercises and movement patterns. These basic exercises emphasize maintaining the lumbar spine in a neutral position. This first stage of core stability training begins with the patient learning to stabilize the abdominal wall. Proper activation of these muscles is considered crucial in the first stages of a core stability program, before progressing to more dynamic and multi-planar activities. The exercise program should progress sequentially through the fundamental movements as detailed below. The following exercises are to be performed regularly to maximize results, you have to continue the basic pattern even you have mastered the advanced patterns. The patient begins with one to two sets of 15 repetitions and progresses to three sets of repetitions. These exercises are taught initially in either a supine, hook-lying position. The patient can progress to the more functional standing exercises, as control is developed. Important concepts taught at this stage include not tilting the pelvis or flattening the spine. We also emphasize normal rhythmic breathing Abdominal Hollowing The Abdominal Hollowing method to stabilize the spine is based on the Richardson philosophy of trunk stabilization. Often rehabilitation and exercise specialists will use this method of stability as they feel that trunk stabilization retraining should start with reestablishing local lumbar stability first. To instruct your client to perform the Abdominal Hollowing technique follow the following directions: Let your client lay down on the floor or on a treatment table in a supine hook-lying position. Stand next to the client. Ask the client to put both of their hand on their lower abdominal region at he level of their belly button. With permission from the client put your hand on top of their hand as if covering their belly button. Supine

Bent-Knee Raises This is a fundamental exercise for recruiting the deep abdominal muscles and for lumbopelvic control. The patient lies on her back, with knees bent and feet flat on the floor. She then braces the abdominal wall, holding the lumbar spine in a neutral position as described above, and slowly raises one foot cm off the ground with alternate legs. Common errors when performing this exercise include rocking the pelvis, abdominal protrusion, or an inability to maintain the neutral lumbar curve. If this happens, discontinue the exercise for a rest period. Quality more than quantity is stressed. The exercise can progress to alternately extending the legs and lowering to the ground. Once the patient can maintain stability with alternate leg lifts. She can add alternate, overhead arm raises for greater challenge. The arm raises should be performed slowly, while maintaining lower abdominal bracing. It specifically engages the multifidi-the deep transverse spine stabilizer and extensor of the lumbar spine. The patient should position herself on all fours. She then braces the abdominal wall as described above. If it helps to maintain alignment, the patient may use an object, such as a foam roller or wooden dowel, placed along the spine, for added tactile feedback. The leg should be raised only to the height at which patient can control any excessive motion of the jumbo-pelvic region. She then performs the exercise raising the left arm with the right leg. A Physioball underneath the trunk can provide significantly more proprioceptive challenge owing to its unstable surface. The goal once again is for the patient to maintain lumbar stability while the opposite arm and leg are raised slowly. The patient begins the exercise on her back, in a hook-lying position, with arms resting at her sides. She activates the abdominals and squeezes the gluteal cheeks prior to initiating the movement. The patient lifts the pelvis and hips off the ground while maintaining neutral lumbar alignment. There should be no rotation of the pelvis. The hips should be aligned with the knees and shoulders in a straight line. The patient should hold the position for 10sec and then slowly lower the pelvis to the floor. In the lifted-bridge position, while maintaining neutral lumbar and pelvic alignment. By placing her arms across her chest, she can increase the challenge of stabilising the lumbo-pelvic region. To progress further, the patient can raise both arms up to the ceiling and then move one arm out to the side. She should bring the arm back to the centre and repeat with the other side. Bridging Prone Plank This is a fundamental, static core-stability exercise. The patient supports herself with her forearms resting on the mat, elbows bent at 90 degree, and the toes resting on the mat. The patient maintains the spine in a neutral position, recruits the gluteal muscles, and keeps the head level with the floor.

## Chapter 2 : Conditioning to the Core: Training for Stabilization, Strength, and Power

*An alternative term to "core stability" is "motor control" that reflects concepts around lumbar stability in a more holistic approach including: the brain, sensory inputs, motor outputs, mechanical properties of muscles/joints, what is normal/abnormal and what may be adaptive/maladaptive.*

This article has been cited by other articles in PMC. A common conservative treatment is therapeutic core stabilization exercises, which can address pain and musculoskeletal dysfunction in patients with low back pathology. Keywords and keyword combinations searched included motor control exercise, segmental stabilization, core stabilization, transversus abdominis, multifidi, and low back pain. There are 2 popular rehabilitation strategies to assess core function and promote core stabilization. Each has been developed based on biomechanical models of lumbar segmental stability and observed motor control dysfunction in patients with low back pain. Controversy exists among clinical and research groups as to the optimal strategy for an athlete with low back pain. An athlete with low back pain is frequently evaluated and treated by multiple members of the sports medicine team. Numerous conservative and invasive treatments have been advocated, each with various levels of efficacy. Core Region and Core Stabilization Athletic performance depends on the creation and transfer of forces between segments of the body. During sport or other activities, the core region plays an integral role in reducing the risk of back injury. Through mechanical modeling, biomechanists have described energy wells potential energy state and the relationship between spinal segments , whole body stability factors that respond to loads or perturbations , elastic energy and stiffness joint stiffness as a result of muscular activation , and sufficient stability adequate activation for functional movement to define requirements for a stable spine. Local Versus Global Approach Current rehabilitation and training strategies for the core have been influenced by biomechanical models of stability. When activated, the muscles of the core increase stiffness, enhancing stability. Bergmark categorized muscles that stabilize the spine as either local or global. In addition, there were additional changes in the motor control strategy of the TA: The change in anticipatory function mirrored the response of other abdominal muscles to direction-specific forces, a change from tonic to burst contractions, and an ability to contract only in response to fast movements. Activation of the TA should be also assessed in prone and supine positions Table 1 , Figure 1. Motor control tests for local muscles: Once the patient qualitatively demonstrates proficiency in this position, he or she progresses to the prone test. Abdominal drawing-in test performed in prone position Patient prone. Performance of the TA contraction is assessed using a stabilizer Chattanooga, Vista, California or pressure biofeedback device. The bladder of the device, with the navel positioned in the center, is inflated to 70 mmHG. The patient is instructed to perform the drawing-in maneuver. Successful performance of the maneuver results in a 6- to mmHg drop in pressure, with each contraction held for 10 seconds. Richardson recommends having the patient perform 10 repetitions to assess muscular endurance capacity. The biofeedback device is placed in the lumbar spine distal portion of bladder at S2 level and inflated to 40 mmHg. The patient is instructed to perform a drawing-in maneuver, which will likely increase the pressure 2 to 4 mmHg. Maintaining pressure during the leg slide demonstrates a level of lumbopelvic control ability to stabilize the trunk on the pelvis during extremity movement.

## Chapter 3 : Core stability - Physiopedia

*address both local stabilizer muscle function, and higher load training for the global stabilizers. The Kinetic Control model has profoundly reframed how I look at rehab.*

Reproduced with permission from Kinetic Control International. Low-load exercise is defined as an exercise the patient can do for four minutes without fatigueor substitutions. We are attempting to retrain and recruit the slow postural muscles that we use to stand, sit and accomplish simple activities of daily living. By going slow and doing sustained activities, we are primarily recruiting the slow-motor units - the postural and tonic motor units within the muscles. The movements must be done with slow, continual movements void of substitutions by other muscle groups, must not have a respiratory cost breath holding , and must be done in the low-threshold environment. These types of exercises will optimize postural control and stability. So, what day-to-day activities or exercises enhance global stabilizers? Ballroom dancing, yoga, Feldenkrais, tai qi or qigong come to mind. Once we add a higher load weights, machines, etc. This recruits the bigger mobilizer muscles and the fast-motor units within the stabilizer muscles. For global-stabilizer training, we are not trying to change muscle structure. Sounds like a chiropractic principle to me! Low-load exercises are mentally challenging. Second, when proprioception is diminished, the sense of effort increases during low-load exercises. The principles for both testing and training are fairly simple. Can these patients control direction-related stress and strain? Our example will be testing for lack of global-extensor function for patients who fail to control flexion. Have the patient flex below the lumbar spine and see if they can maintain the lordosis and hold neutral in the lumbar spine. Craig Liebenson has a nice handout on the hip hinge on his Web site. Can the patient maintain neutral lumbar spine as they do these isolation motions. Watch closely from the side. Another test, done supine hook-lying, is to have the patient lift either one bent leg at a time to 90 degrees, or lift both bent legs. Can the patient maintain the lumbars in lordosis? You can test with a flat hand under the spine. Ideally, put a pressure biofeedback stabilizer unit or blood pressure cuff under the lumbars to give the patient visual feedback. Can they maintain a pound pressure? These same motions can be used as the retraining exercises. I like the ease of these motions. They are not hard for the patient to learn and can really make a difference. The hip hinge is both an exercise and an integration into a functional activity, going from sit to stand. The exercises have to be done with attention to detail, specifically keeping the lumbar spine in neutral and not letting the lumbars flexwhile moving at the hips. Keeping the hips in neutral, rather than letting the knees fall outward or inward, is also important. A brief clinical note: I re-injured my low back two weeks ago, and I kept having morning glitches, little spasms and catches in my right lower back. I noted that my right local multifidi had stopped working properly. I had a huge timing delay again. I worked on this for several days using the exercise I outlined in the local stabilizer section of my previous article. A brief global-stability exercise immediately improved my lumbar motor function. Another patient of mine with chronic low back pain when she gardened, had a similar response. This is not a miracle, just some good changes. The goal is to introduce you to some newer concepts and some new ways of looking at rehab. You may already be teaching some of these exercises. Perhaps you will look at them differently, see where they fit and for whom they work. This model has profoundly reframed how I look at rehab. I hope these ideas help you and your patients as well. Stability of the lumbar spine. A study in mechanical engineering. Acta Orthop Scand Suppl, ; Back muscle activation pattern and spectrum in defined load situations. Pathophysiology, Dec;12 4: Click here for more information about Marc Heller, DC.

## Chapter 4 : Exercises for Lumbar Instability - Physiopedia

*These systems include the local muscular system, also known as the stabilization system, and the global muscular system, often times referred to as the movement system. The local musculature system is composed of muscles that are predominantly involved in support and stabilization of the spine.*

Stability is provided in a co-ordinated manner by the active eg muscles , passive eg lumbar spine and control eg neurological systems. Correct and incorrect abdominal drawing in Figure 2: Plank on a medicine ball Training the local muscles developed by physiotherapists is a complex skill for participant and trainer that requires precise and rigorous assessment, exercise instruction and feedback. Training the superficial muscles can be equally complex and is undertaken by a range of health and sporting professionals with a large variety approaches evident. Transversus abdominis from http: Lumbar multifidus on the left of the spine from http: Inferior view of the diaphragm from http: A medial view of the left pelvic floor from http: These muscles generate torque, act like guy ropes to control spinal orientation and work in co-contraction to control spinal motion in the application of external loads. The anatomy of these muscles is easily accessible online or in standard texts. An understanding of a normal response is required for the abdominal drawing in maneuver transversus abdominis , isometric activation of multifidus, normal breathing diaphragm and pelvic floor activation. Clinical methods have been published in texts, [5] journals, [9] and online http: The use of diagnostic ultrasound can also be of value as an adjunct to clinical methods. There are definitive texts on this topic [10] as well as specific tests listed below: Practitioners treating people with significant pathology where local muscle dysfunction is likely should retrain specific motor control before moving onto more global training. Crunches- Lie supine on the floor with your knees bent, arms crossed over your chest and the feet flat on the floor. Then lift your schoulders from the ground and curl you stomach. Avoid a full sit up and ensure the low back remains in contact with the floor. See demonstration video below. Obliques crunches - As per a normal crunch but leading with one shoulder towards the opposite knee alternate sides each repetition. Plank - Lie prone on the floor. Then while keeping your whole trunk straight like a plank lift up onto your forearms, with the elbows right under the shoulders, and toes. Hold this position as long as possible with control. To make the exercise more difficult try to lift one leg slightly of the ground. The plank can also be done on your side while supported by your feet and your forearm with your shoulder above your elbow. See video demonstration below. Bridges - Lie supine with your knees bent and the feet flat on the floor. Lift your pelvis of the ground while supporting on your feet and shoulders. The bridge can be progressed by lifting one foot off the ground end extending the knee. Raise one leg behind you until it is horizontal. Superman â€” As per a hamstring raise but progress by lifting the opposite arm to a horizontal position at the same time. Leg raises - Lie on your back with your legs straight and your arms by your sides. Then lift one leg 4 inches of the ground. Your back has to stay flat on the floor. The exercise can be progressed by lifting both legs at the same time. Hundreds - Lie on your back with your legs straight and your arms by your sides. Then lift both legs so that they form a right angle in the hip and knees. Lift your arm straight a few inches off the ground. Then simply tap the ground times. Focus on keeping your hips and legs completely still and your back flat. Leg extensions - Lie on your back with your legs straight and your arms by your sides. Then keeping the knee straight lift one leg until the foot is 4 inches off the ground. There are also multiple exercises that can be performed with a physioball. The exersises where proven to have a greater gain of torso balance and neuronal activity then regular floor exercises.

## Chapter 5 : Core Stabilization Exercise Prescription, Part I

*â€¢ Training movement system muscles before training muscles of global and local stabilization systems would not make sense from structural and biomechanical standpoint. Doing so would be analogous to building a house with no foundation.*

The OPT model is divided into three different blocks of training and each building block contains specific phases of training that systematically advances the student in a safe and progressive manner. Exercises can be categorized by adaptation and by type of exercise: Stabilization, Strength, or Power be familiar with all exercises listed, as well as how to regress and progress the exercises listed Type of Exercise: Strong and efficient core is necessary for maintaining proper muscle balance throughout the entire human movement system kinetic chain. Optimal length-tension relationships, recruitment patterns, and joint motions in muscle of LPHC establish neuromuscular efficiency throughout entire human movement system. Allow for efficient acceleration, deceleration, and stabilization during dynamic movements, as well as prevention of possible injuries. Local Stabilization System Local stabilizers are muscles that attach directly to vertebrae. Consist primarily of slow twitch type I fibers with high density of muscle spindles. Work to limit excessive compressive, shear, and rotational forces between spinal segments. Primary muscles that make up local stabilization system include transverse abdominis, internal obliques, multifidus, pelvic floor musculature, and diaphram. INcrease intra-abdominal pressure pressure within abdominal cavity and generating tension in thoracolumbar fascia connective tissue of low back , increasing spinal stiffness for improved intersegmental neuromuscular control. These transfer loads between upper extremity and lower extremity, provide stability between pelvis and spine, and provide stabilization and eccentric control of the core during functional movements. Primary muscles that make up global stabilization system include quadratus lumborum, psoas major, external obliques, portions of the internal oblique, rectus abdominis, gluteus medius, and adductor complex. These muscles are primarily responsible for concentric force production and eccentric deceleration during dynamic activities. Primary muscles that make up movement system include latissimus dorsi, hip flexors, hamstring complex, and quadriceps. Collectively all muscles within each system provide dynamic stabilization and neuromuscular control of entire core LPHC. These produce force concentric , reduce force eccentric , and provide dynamic stabilization in all planes of movement during functional activities. In isolation, these muscles do not effectively achieve stabilization of LPHC; rather it is through their synergistic interdependent functioning that they enhance stability and neuromuscular control. Training movement system muscles before training muscles of global and local stabilization systems would not make sense from structural and biomechanical standpoint. Doing so would be analogous to building a house with no foundaiton. Importance of Properly Training the Stabilization Systems Some active individuals have developed strength, power, and muscular endurance in the movement system, which enables them to perform functional activites. Few people have developed the local stabilization muscles required for intervertebral stabilization. If movement system musculature of the core is strong and local stabilization system is weak, the kinetic chain senses imbalance and forces are not transferred or used properly. This leads to compensation, synergistic dominance, and inefficient movements. Weak core can lead to inefficient movement and predictable patterns of injury. Resulting in lower back pain and injury. Scientific Rationale for Core Stabilization Training Individuals with chronic LBP have decreased activation of certain muscles or muscle groups, including transverse abdominis, internal obliques, pelvic floor muscles, multifius, diaphram, and deep erector spinae. Also waeaker back extensor muscles and decreased muscular endurance. Studies support role of core training in prevention and rehabilitation of lower back pain. Core stabilization exercises restore size, activation, and endurance of multifidus deep spine muscle in individuals with lower back pain. Programs that include specific core stabilization training tend to be more effective than manual therapy alone. Drawing-in Maneuver â€” Used to recruit the local core stabilizers by drawing the navel in toward the spine. Bracing â€” Occurs when you have contracted both the abdominal, lower back, and buttock muscles at the same time. Traditional low-back hyperextension exercises without proper lumbo-pelvic-hip stabilization have been shown to increase pressure on discs to dangerous levels. Drawing-in Maneuver Research has demonstrated electromyogram EMG activity is increased during pelvic stabilization and transverse abdominis activation when an abdominal drawing maneuver is initiated before activity. Transverse abdominis, when properly activated, creates tension in thoracolumbar fascia, contributing to spinal stiffness, and compresses sacroiliac joint, increasing stability. Pull region just below navel toward spine and maintain cervical spine in neutral position. Maintaining neutral spine during core training helps improve posture, muscle balance, and stabilization. If forward protruding head is noticed during drawing-in maneuver, sternocleidmastoid large neck muscle is preferentially recruited, which increases the compressive forces in the cervical spine and can lead to pelvic instability and muscle imbalances as a result of the pelvo-ocular reflex. Important to maintain the eyes level during movement. Bracing Co-contraction of global muscles, such as rectus abdominis, external obliques, and quadratus lumborum. Muscular endurance of global and local musculature, when contracted together, create the most benefit for those with LBP compared with traditional LBP training methods. Bracing focuses on global trunk stability, not on segmental vertebral stability, meaning that the global muscles, given the proper endurance training, will work to stabilize the spine. Guidelines for Core Training Core training should be systematic, progressive, functional, and emphasize the entire muscle action spectrum focusing on force production, force reduction, and dynamic stabilization. Core training program should regularly manipulate plane of motion, range of motion, modalities tubing, stability ball, medicine ball, Bosu ball, Airex pad, etc. When designing core training program, personal trainer should initially create a proprioceptively enriched controlled yet unstable selecting appropriate exercises to elicit maximal training response. Core exercises performed in unstable environment such as with stability ball have been demonstrated to increase activation of local and global stabilization systems when compared to traditional trunk exercises. Safe and challenging, stress multiple planes in a multisensory environment derived from fundamental movement skills specific to activity. Designing a Core Training Program Goal of core training is to develop optimal levels of neuromuscular efficiency, stability intervertebral and lumbopelvic stability-local and global stabilization systems and functional strength movement system. Neural adaptations become focus of program instead of absolute strength gains. Increasing proprioceptive demand is more important than increasing external resistance. Quality of movement should be stressed over quantity. Client beings at highest level at which they are able to maintain stability and optimal neuromuscular control coordinated movement. Progresses through program once mastery of exercise in previous level has been achieved while demonstrating intervertebral stability and lumbopelvic stability. Client has appropriate lumbopelvic stability when able to perform functional movement patterns squats, lunges, step-ups, single-leg movements without excessive spinal motion flexion, extension, lateral flexion, rotation, singly or in combination. Critical that core training program is designed to achieve following functional outcomes: Intervertebral stability, lumbopelvic stability, movement efficiency Levels of core training Three levels of training within OPT model, stabilization, strength, power, proper core training program follows same systematic progression. Designed to improve neuromuscular efficiency and intervertebral stability, focusing on drawing-in and then bracing during the exercises. Traditionally spend 4 weeks at this level of core training. Specificity, speed, and neural demands are progressed at this level. Prepare an individual to dynamically stabilize and generate force at more functionally applicable speeds. Rotation chest pass, medicine ball pullover throw, front MB oblique throw, soccer throw. Core musculature helps protect spine from harmful forces that occur during functional activities. Core program designed to increase stabilization, strength, power, muscle endurance, and neuromuscular control in LPHC. Core training programs must be systematic, progressive, activity or goal-specific, integrated, and proprioceptively challenging. Proper core training follows same systematic approach as OPT model: Ex if client is in stabilization level phase 1 select core stabilization exercises. For client in strength level, select core-strength exercises.

## Chapter 6 : Phase 1: Stabilization Endurance (Total Body) Workout Routine

*The primary indication for needing/doing global stability training is a recurrence of movement related pain or direction-specific stress or strain. The classic examples are the patients who always seem to get worse when brushing their teeth, loading dishes, gardening, etc.*

The muscular structures of the abdominal and back regions play a dominant role in postural control, lumbar stabilization, and proprioception what we call total body balance. As we have said, a well-functioning core can help reduce the risk and severity of injury and promote greater efficiency. Precise movements such as lifting a baby from a crib or throwing a dart would not be possible without effective involvement of the core musculature. Tasks that demand synchronous strength, such as standing in strict military posture for an extended time or maintaining balance while exiting a ski lift, similarly require core involvement. In addition, power-based tasks such as sprinting, swinging a golf club, or dunking a basketball would be impossible without a stable core. You might ask how the core is involved in throwing a dart. The answer is that we must use the deep stabilizers to isometrically and dynamically sustain the kinetic chain during energetic movements within all three planes of motion. More simply stated, stabilization provides a strong foundation through which an action such as throwing a dart can occur most efficiently, powerfully, and accurately. Action is never plane-specific. That is, even though your movement is taking place in one plane, the other two planes must be stabilized for the action to be successful. How accurate can a dart-throw be from a core foundation as wobbly as a cube of Jell-O? Force reduction, stabilization, and force production within all planes of movement is the template for training the entire kinetic chain. In training, as we have stated before, stability is trained before strength, and strength is trained before power. A stable core is no doubt important to everyday activities, but for optimal athletic performance stabilizing the core is imperative. Eastern philosophers have been preaching core stability for thousands of years. Trunk and torso stabilization techniques are as much a daily ritual for them as are eating and sleeping. The view is that you enhance your quality of life through maximizing efficiency of physical function. Eastern martial artists routinely focus the greatest percentage of their training time on the development of the "Hara" the core , the physical center of being. Relaxation of the muscles promoted by a strong core allows for greater freedom of movement, better control of power within a movement, less extraneous movement, and most important, the conservation of energy through efficient movement. Controlled body movement is also a prerequisite for accuracyof skill. The power developed in the core must eventually travel through the musculoskeletal system to the more precision-oriented distal musculature of the extremities. Only after achieving this ability to channel energy can you begin to realize your tremendous physical potential - and it all starts with the core. Characteristics of Good Balance Balance is the result of correct body alignment and fully functioning sensory mechanisms. The proper synergism between the core and the legs, arms, feet, hands, and head is essential to achieving correct body alignment. From an athletic perspective, someone who is standing and is balanced in an athletic stance typically demonstrates the following: The knees are flexed rather than straight, creating a slightly lower center of mass. The base of support is comfortably wide, with feet parallel. Body weight is slightly forward of the midpoint of the foot. The center of mass is dynamic; that is, the athlete continually uses rapid yet controlled motion to respond to sudden changes of direction. The ability to accurately adjust to changes in your position or to an unstable equilibrium and to sense your limitations in the constant battle against gravity indicates accomplished balance. Most great athletes possess such balance without even realizing it. Dynamic Balance Maintaining balance and stability is a dynamic process. Your body is continually trying to achieve a state of equilibrium. Several mechanisms within the body continually process information in an effort to attain this state. Two of the more athletically relevant sources of feedback include the vestibular apparatus within the inner ear and proprioceptors within the muscles and joints. Proprioceptors, such as the muscle spindle and Golgi tendon organ, sense the magnitude and speed of a stretched muscle and changes in joint angles. These sensors provide input necessary to make immediate and essential adjustments in balance. A good example of your receptors at work is that disturbing feeling of just beginning to nod off, only to be abruptly jerked back to reality. For example, while sitting in the film room listening to an unbearably boring lecture on postural assessments and realizing that you can never possibly get back these wasted four hours of your life, you begin to doze off and your head starts to drop forward. The muscle spindles in the back of your neck sense the stretch placed on the neck musculature and quickly make a correction by firing those same muscles and returning your head to upright position. From a stabilization, balance, and postural standpoint, refining your proprioceptor sensors enhances athletic performance and reduces injury risk. The Importance of Good Posture Poor posture affects not only balance but all other athletic performance variables. Keep in mind that force is more effectively transferred through a straight line. Obviously, there are natural curvatures throughout the body, but generally speaking, you should strive for proper body alignment between segments - particularly during the push or explosive phase of a movement. A person with poor posture lacks that straight line. The preferred path of force transfer is through the skeletal system. Poor posture, however, causes detours in the force transfer because the smaller and weaker muscles outside the core must act as the force conduit. Much wasted energy results, and subsequent and usually more severe breakdowns are inevitable. Poor posture leads to countless mechanical and structural problems, some of which we touched on in chapter 3. Training for Strength We can break strength down into two categories: In its strictest sense, muscular strength is the maximum amount of force that a muscle can generate against resistance in a single effort. In contrast, muscular endurance is the ability of a muscle or group of muscles to exert force for a sustained time, such as when running, raking leaves, or hitting hundreds of forehands over the course of a tennis match. From an athletic perspective, both muscular strength and muscular endurance are critical for performance enhancement, functional stabilization and dynamic postural control of the spine, and efficient biomechanical movement throughout the kinetic chain. Most people think of strength in terms of how much can I lift? In fact, strength - and specifically core strength - is an integral protective mechanism that helps eliminate postural distortions that can lead to ineffective neuromuscular proficiency. Low strength levels at any point within the kinetic chain place the athlete at risk for compensation issues that can elicit extra stresses placed on the contractile and noncontractile tissues, which will adversely affect functional movement patterns and place the athlete at greater risk of injury. Conversely, strong muscles provide efficient dynamic stabilization, decrease the risk of serial distortion patterns, and transmit forces to the bones, acting as levers and resulting in precise and effectual movement. Unfortunately, most coaches and athletes view strength in its absolute sense - the greater weight that can be lifted translates to heightened performance on the court or field. Strength is but one component within a complex system of a multisensory sport performance. Without stabilization, strength cannot be fully developed. Without strength, stabilization - or the lack thereof - will decrease performance and expose the weak link in the kinetic chain. Without both stability and strength and the refined neuromuscular efficiency associated with the systematic functioning of their relationship, athletes cannot hope to fully develop their power potential. If you are new to strength training, we encourage you to take the same approach to training for strength as for the global development of all physiological processes. As we have mentioned, enhanced motor skill development evolved following a proximal-to-distal progression. Your strength training should follow a similar course, with emphasis on developing core strength before implementing extremity exercises. Once you have established a foundation of strength, you can then focus on the quality of technique and execution over quantity with regard to load and repetitions. Quality is nearly impossible without the proper foundation from which to execute the activity. In addition, once foundational core development has been established, you can begin to focus on sport specific - related movements without risking deleterious technical inaccuracies. Training for Power Assimilating stability and strength is an important part of developing your center of power. Sport movements, however, typically require explosive, ballistic, and well-coordinated muscular actions. The ability to take strength gained from the weight room and apply it effectively on the playing field is the goal of any performance-enhancement program. Power and strength are not synonymous. As such, the strongest athlete is not necessarily the most powerful athlete. Power conditionally relies on the correlation between strength and speed - thus the clever phrase "speed strength. Simply put, power is a relationship between strength and speed. To this point we have discussed strength, but what exactly is speed? How important is speed? How is speed developed? Speed can be broadly defined as the elapsed time it takes to move from point A to point B. The distance between point A and point B could be the  Once you combine speed with strength, the long hours of strength training in the weight room start to pay off, and sport-specific, or functional, strength starts to translate to power. Thus power is the product of force the weight room and velocity the functional application. It should come as no surprise that all of this begins at the core. Developing Speed Developing the speed component of power differs dramatically from standard programs designed to enhance strength. Typically, you increase your muscular strength through consistent and progressive overload training increasing load. Training for enhanced speed can certainly be influenced by regular trips to the weight room; however, the level of change is more often a predisposition of unseen factors. These considerations, along with diligent workouts, determine the ultimate level of speed development. These factors are individual genetic characteristics and the physiology of the muscular system. For our purposes here, we will simplify the physiology and discuss two types of muscle fiber: Fast-twitch muscle fibers exert great power but fatigue quickly. The body generates the energy required to contract a fast-twitch fiber anaerobically, or without oxygen. These fibers are best suited for short, explosive actions, such as sprints, Olympic lifting, or volleyball spikes. In contrast, slow-twitch muscle fibers require oxygen for sustained contraction and are thus ideal for endurance activities, such as cross-country skiing, marathon running, or road cycling. Athletes who participate in endurance sports typically have a higher percentage of slow-twitch fibers. Conversely, the muscles of athletes whose sports require explosive actions tend to contain a higher percentage of fast-twitch fibers. Most elite-level athletes gravitate toward sports that are compatible with their genetic makeup remember that we are simplifying the physiology. All of us were born with a certain ratio of fast-twitch to slow-twitch fibers. Even if your muscles are predominantly slow-twitch, however, does not mean you are destined to remain slow. Clearly, you will never become as fast as a cheetah, but you can always become faster than you are right now.

## Chapter 7 : Muscles of the Core | Train for Life

*There are 2 popular core stabilization rehabilitation strategies: the motor control exercise approach, emphasizing specific training exercises for local muscles, or the general exercise approach, which includes exercises for global muscles. 16,22 These strategies differ in part because of the interpretation of the biomechanical role of the.*

This article has been cited by other articles in PMC. Enhancing core stability through exercise is common to musculoskeletal injury prevention programs. Definitive evidence demonstrating an association between core instability and injury is lacking; however, multifaceted prevention programs including core stabilization exercises appear to be effective at reducing lower extremity injury rates. PubMed was searched for epidemiologic, biomechanic, and clinical studies of core stability for injury prevention keywords: Articles with relevance to core stability risk factors, assessment, and training were reviewed. Relevant sources from articles were also retrieved and reviewed. Stabilizer, mobilizer, and load transfer core muscles assist in understanding injury risk, assessing core muscle function, and developing injury prevention programs. Moderate evidence of alterations in core muscle recruitment and injury risk exists. Assessment tools to identify deficits in volitional muscle contraction, isometric muscle endurance, stabilization, and movement patterns are available. Exercise programs to improve core stability should focus on muscle activation, neuromuscular control, static stabilization, and dynamic stability. Core stabilization relies on instantaneous integration among passive, active, and neural control subsystems. Core muscles are often categorized functionally on the basis of stabilizing or mobilizing roles. Neuromuscular control is critical in coordinating this complex system for dynamic stabilization. Comprehensive assessment and training require a multifaceted approach to address core muscle strength, endurance, and recruitment requirements for functional demands associated with daily activities, exercise, and sport. Even though limited evidence exists, the integration of core stabilization exercises into injury prevention programs, particularly for lower extremity, is demonstrating decreased injury rates. A universally accepted definition of core stability is lacking. Generally, core stability comprises the lumbopelvic-hip complex and is the capacity to maintain equilibrium of the vertebral column within its physiologic limits by reducing displacement from perturbations and maintaining structural integrity. Several authors have proposed a more functional perspective to describe the core as the foundation of the kinetic chain responsible for facilitating the transfer of torque and momentum between the lower and upper extremities for gross motor tasks of daily living, exercise, and sport. Movement beyond the neutral zoneâ€”a region of high flexibility and little resistance around the neutral spine positionâ€”requires muscular constraints for stabilization. The primary function of these static tissues is to stabilize in the end range of motion as tensile forces increase and mechanical resistance to movement is produced, as well as to transmit position and load information to the neutral control subsystem via mechanoreceptors. The neural control subsystem is the center for incoming and outgoing signals that ultimately produce and maintain core stability. The increased popularity of core stability has also led to the development of several classification systems to describe core muscle function for dynamic stabilization. The function of muscles is determined by their unique morphology, including architectural aspects of fiber length and arrangement. However, Gibbons and Comerford 24 and Behm et al 7 believe that the function of relevant muscles is more complex and that no single category is more important than another. Stabilizers generate force eccentrically to control movement throughout range of motion, while mobilizers concentrically accelerate through range of motion and act as shock absorbers, especially in the sagittal plane. Behm et al 7 also maintained the local stabilizer category and divided the global muscles into mobilizers and transfer load categories. Injury Risk Core stability exercises are implemented according to the theoretical framework that dysfunction in core musculature is related to musculoskeletal injury; therefore, exercises that restore and enhance core stability are related to injury prevention and rehabilitation. To date, there is no clear evidence that supports the relationship between poor core stability and musculoskeletal injury. Substantial evidence exists demonstrating core muscle recruitment alterations in low back pain LBP patients compared with healthy controls. Hodges et al examined core muscle recruitment patterns during upper 29 and lower 28 extremity movements in LBP patients compared with healthy controls. Consistently, the transversus abdominus was the first muscle recruited, followed by the multifidus, obliques, and rectus abdominus. All local stabilizer and global mobilizer core muscles were recruited before any extremity movement, indicating that core muscles provide proximal stability for distal mobility. In the LBP patients, transversus abdominus recruitment was delayed in upper and lower extremity movements in all directions flexion, extension, abduction. Multifidus and internal oblique recruitment in patients with sacroiliac joint pain during an active straight-leg raise maneuver was delayed until after the leg raise was initiated, indicating a lack of preparatory activation for proximal stability. The gluteus maximus activation was also delayed, suggesting an inability to compress and stabilize the sacroiliac joint and pelvis with associated lower extremity movement. Overall, these studies 28 , 29 , 32 illustrate alterations in muscle recruitment, suggesting that deficiencies in core stabilization and load transfer muscles may be related to lower extremity function and injury. Few studies demonstrate muscle weakness associated with injury status. Leetun et al 40 studied core stability and lower extremity strength test differences between men and women in relation to athletic injury during the season. They conducted preseason core stability tests and isometric strength testing of hip abduction and external rotation on athletes who were tracked for injuries through one competitive season. Men had higher overall core and hip strength values than women, with significant differences in hip abduction, hip external rotation, and the side-bridge test. Athletes who suffered an injury during the season generally had lower values for hip and core strength; however, only hip strength tests were found to be significantly different. They concluded that hip external rotation strength was the strongest predictor of injury. Interestingly, the majority of studies report alterations in muscle recruitment ie, timing, amplitude, and endurance , not decreased strength, indicating that core dysfunction may be more of a neuromuscular control problem than a strength problem. The neuromuscular mechanisms of noncontact anterior cruciate ligament risk factors 40 , 64 , 65 and prevention programs 31 , 33 , 37 , 52 , 53 , 60 , 61 have begun to explain an association between core stability and lower extremity musculoskeletal injury. The premise for the association is based on muscle attachments. The muscles of the hip, or the load transfer muscles, have pelvic and lumbar attachments. Compromised core stability creates an unstable proximal base, thus limiting control and positioning of the lower extremity for functional movements and loads and increasing injury risk. Zazulak et al prospectively measured core neuromuscular control properties of active proprioceptive repositioning 65 and trunk displacement 64 in collegiate athletes, followed by injury tracking over 3 years. Core stability is a primary component of functional movement, essential in daily living and athletic activities. The evidence supporting the association between poor core stability and injury risk continues to lag behind popular beliefs and practices. As a result, clinicians are continually challenged with best practices for assessing and training core stability. Assessing Core Stability Prevention programs that target core stability focus on enhancing the recruitment of the local and global stabilizer, global mobilizer, and load transfer muscles, restoring muscle strength and endurance and regaining posture and balance through regulation of the neuromuscular control system for overall improvements in function Figure 1. Core stability is a complex interaction among local, global, and load transfer muscles, neuromuscular control, and the specific demands of the task being performed. No less complex is the challenge of accurately assessing core stability. A plethora of tests measure core stability, many of which are reliable and valid. The sheer quantity of tests that assess different dimensions highlight the complex and multidimensional role of the core along the kinetic chain for functional movements.

## Chapter 8 : How Can One Strengthen Stabilizer Muscles?

*Prevention programs that target core stability focus on enhancing the recruitment of the local and global stabilizer, global mobilizer, and load transfer muscles, restoring muscle strength and endurance and regaining posture and balance through regulation of the neuromuscular control system for overall improvements in function (Figure 1). 6.*

This can be unilateral of bilateral. People with weak muscle strength and endurance are at greater risk for low back pain. It has been shown that weak trunk extensors may lead to chronic low back pain. Being overweight is also a suggested risk factor but some studies do not support this. Lumbar instability is one of the subgroups of non-specific low back pain. Implications of instability are pain, functional disability and reduced muscle endurance. The kind of exercises depends on the status of the patient. Stabilizing and mobilizing muscles that affect the low back Indications for exercises There are different reasons why we might give stabilisation exercises to patients with lumbar instability. The most important considerations are our treatment goals and the likelihood of a positive response to treatment. An important study by Hicks et al shows that during the examination of lumbar instability positive and negative determinants can be found indicating whether a subject will benefit from a low back stabilization program. Stabilisation exercise programs exist of general exercises, educational and workplace-specific back school classes, increase of workload tolerance, psychological interventions and segmental stabilization exercises. The stabilizing exercises focus on the re-education of a precise co-contraction pattern of local muscles of the spine. Stabilizing exercises are therefore recommended in the treatment of patients with lumbar segmental instability. Each stage includes clinical assessments of the level of impairment in the joint protection mechanisms, followed by the suggested exercise techniques. These include the transversus abdominus TrA , quadratus lumborum, oblique abdominals, multifidus and erector spinae. Exercises targeting these specific muscles should be done in a progression, usually beginning with TrA which provides the patient with initial stabilization that is helpful during subsequent exercises and daily activities. Basic Activation Depending on treatment findings, a patient may need to start with some basic muscle activation. A stabilizer has come into general use for stabilization exercises for all parts of the body. A stabilizer is a pressure biofeedback unit and consists of an inelastic, three-section air-filled bag, which is inflated to fill the space between the target body area, a firm surface and a pressure dial for monitoring the pressure in the bag for feedback on position. The bag is inflated to an appropriate level for the purpose and the pressure recorded. Movement of the body part off the bag results in a decrease in pressure while movement of the body part into the bag results in an increase in pressure. Its use in assessing the abdominal drawing-in action has become its most important use in relation to the treatment of problems for the local muscle system in patients with low back pain. The feet remain flat and the arms are held alongside the body. The stabilizer is positioned under the lumbar lordosis. During exercises the spine cannot make any movements. The transversus abdominis TrA is contracted while doing the exercises to maintain an appropriate position. Below the woman is holding the feedback unit to monitor the amplitude of her spinal movement based on the pressure change on the dial. Foundation Movements 1 Contraction of TrA without contraction of the overlying abdominals Normally TrA should be in a state of continual contraction whether in standing and sitting, facilitating good posture. In patients with low back pain, TrA can become deactivated, leading to an unstable core but additional global musculature may also be co-contracted in an effort to regain some control. The goal of this exercise is that patients with low back pain learn to contract TrA at all times except when lying. After a time the muscle should return to its natural state of continuous contraction. It is very important for patients with low back pain to have good posture which will be assisted by retraining TrA. The patient pulls his belly in and up at the navel without moving the rib cage, pelvis or spine. Gradually build up the duration of the contraction. People with low back pain often lose the ability to contract this muscle and they do not regain the ability spontaneously. First the patient learns to recognize what is feels like to tense and relax the muscle then also how to include the lateral abdominals in the contraction. People with low back pain do not have the ability to perform pelvic tilting. You can see excessive flexion laxity but limited or blocked extension. The ability to dissociate lumbar movement from pelvic movement is therefore important and correction of faulty lumbar-pelvic rhythm is vital. People with respiratory disease are predicted to have increased incidence of low back pain. Facilitate active pelvic tilt. Prone kneeling with shoulders directly above the hands and hip above the knees Phase 1 a: Lumbar flexion and some thoracic flexion finish the action d: Faulty lumbar-pelvic rhythm often shows up when lumbar flexion and posterior pelvic tilt occur immediately. They exhibit also a limited excessive flexion laxity or blocked extension. Use a pelvic tilt action to move the spine forward and backward. Once you can perform pelvic tilting well, you should combine it with classic hip in a hinge action where the trunk moves on the hip in a hinge action and the spine remains straight. Avoid any increase or decrease in lumbar lordosis! Draw the abdominal muscles and maintain this minimal contraction throughout the movement! Teach anterior-posterior pelvic tilt control. Sit on the ball with knees apart and feet flat on the floor. Tilt pelvis alternately in both anterior and posterior directions, making sure the shoulders and thoracic spine remain inactive. Start with small ranges of movement. Gradually work up to larger ranges. Teach clients to learn to use the multifidus at will and seperately from other muscles. The multifidus is the most important stabilizer of the spinal extensor group. People with low back pain often lose the ability to contract this muscle and do not regain the ability spontaneously. Prone-lying position Therapist palpates the multifidus. Bulge the muscles beneath the fingers of the therapist and differentiate between erector spinae contraction more lateral and multifidus contraction more central. To contract only the multifidus muscle, the patient may not hyperextend the trunk. Sitting Multifidus contraction Goal: Encourage your client to contract the multifidus and lateral abdominals simultaneously. Client sit on the edge of a bench with his feet on the floor. Lumbar spine in neutral position. Therapist palpates the multifidus. Client performs abdominal hollowing If the therapist feels the contraction, the client can self-palpate and continue the action for 10 repetitions, aiming to hold each for 10 s while breathing normally. Stand with one foot in front of the other Self-palpate the L4-L5 level by placing the thumbs on the lower lumbar spinous process and moving them outward slightly into the spinal tissue. Place the weight onto the front leg and then onto the back leg alternately. Feel the muscles beneath the thumbs switching on and off. Progressing Stability Training [3] Goal: Place minimal but progressive limb loading on the trunk. Slowly straighten one leg with the heel resting on the ground. The moment the pelvis anteriorly tilts and the lordosis increases, you must stop the movement and draw the leg back into flexion. Patient has to lie down and dorsiflex the toes. After that contract the gluteal muscles.

## Chapter 9 : Core stability - Wikipedia

*Scientific Rationale for Core Stabilization Training Individuals with chronic LBP have decreased activation of certain muscles or muscle groups, including transverse abdominis, internal obliques, pelvic floor muscles, multifius, diaphram, and deep erector spinae.*