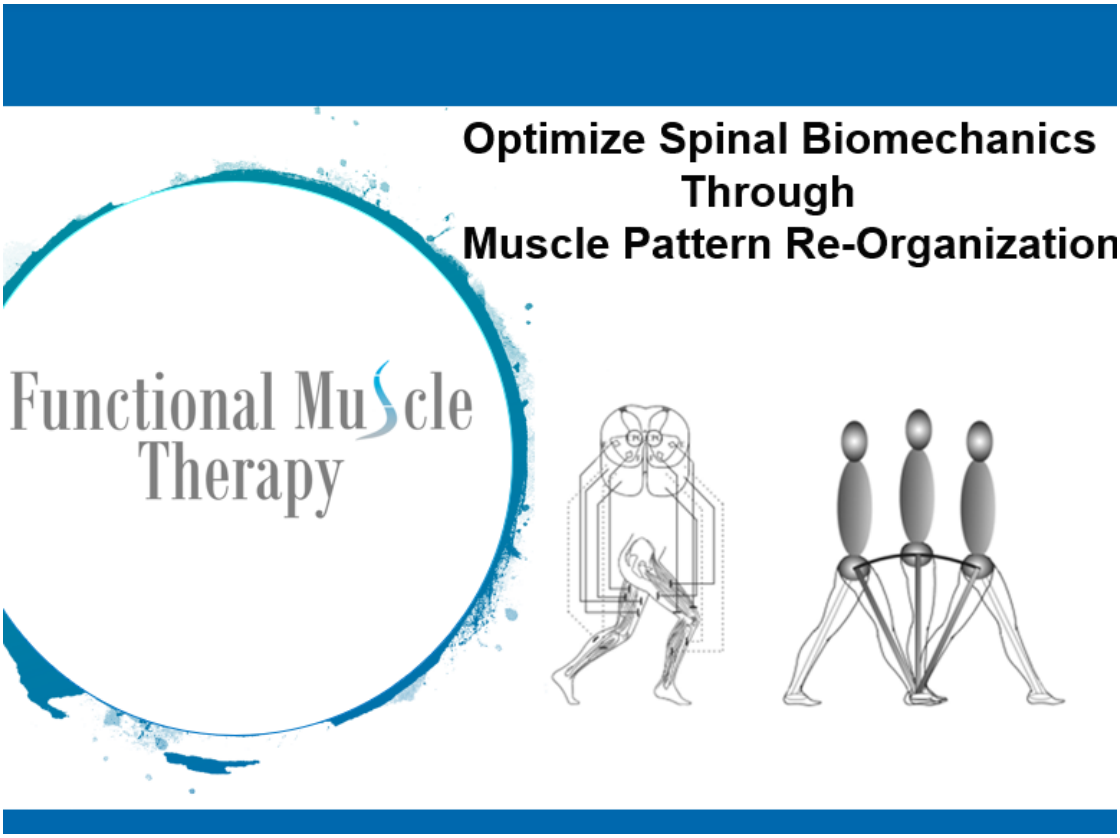
Functional Muscle Therapy



Brian McKeever, M.P.T., A.T.C., C.E.A.S

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Chapter 1

How to use this Manual
Development of Muscle Pattern Re-Organization

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How to Use This Manual

This manual is designed to teach you a sequential and comprehensive process to treat and correct spinal dysfunctions and injuries based on the concept of re-boot, re-built, and restore. You will be given supportive research behind the treatment approach and a description of the biomechanics and kinesiological factors of the most common spinal dysfunctions behind the modern environmental influences. This manual is meant to educate you on the as well as provide you with many principles to help you formulate, develop, and customize your treatment approach as you feel fits best with your patient population. This manual will give examples of treatments and exercises which follow the concept of re-boot and rebuild. Treatment concepts are examples of treatment approaches based on the common kinesiological dysfunctions associated with the body part identified. These examples are designed to guide your through the systematic proprioceptive specific approach of Muscle Pattern Re-Organization and not intended to give you a single specific treatment approach for a given dysfunction. It is the concept and philosophy I hope you will embrace. Use the kinesiological descriptions of common movement dysfunctions and the neuromuscular factors relating to muscle imbalances to guide you in the process of developing your treatment interventions. Using the Muscle Pattern Re-Organization concept, you will find that many of the treatment approaches you already use will fit into this approach with great success. Use the regional interdependence model to create a truly comprehensive approach.

This manual is the home study portion of the Functional Muscle Therapy course. In the fun and interactive live portion of the course, we will learn MyoSequence Technique which is built around restoration of muscle cooperation through sequential proprioceptive specific muscle treatments. You will then learn Muscle Pattern Re-Organization a new exercise strategy using a proprioceptive pattern specific sequence designed to facilitate proprioceptive self-awareness and maintain optimal segmental motor control. All new techniques learned are designed for immediate clinical application.

This manual contributes 7 hours of your CEU's. This is a comprehensive manual intended to be a great resource of information as related to our treatment approach. It would take much more than 7 hours to study and learn all the information contained in this manual.

I will review the key points for the post test during class. If you do not need the CEU's and are taking the course for the hands-on manual therapy portion, the post test is not necessary. You will still receive a certificate of completion for Muscle Pattern Re-Organization Technique

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Development of Muscle Pattern Re-Organization

Early in my career, as director of physical therapy for a large national occupational health clinic, I began to dive into the reasons behind the injuries our clinicians were treating. First, it did not seem to make sense that we were treating repetitive stress or strain injuries with repetitive exercise routines. Second, although it was common knowledge that the movement patterns the employees were performing was the cause of their symptoms; why did the symptoms persist even when the movement patterns and postures were discontinued? I did not stay with this company long as the cookbook approach to work related injuries which they pushed us to use was ineffective. I then opened my own clinic where I would not be hindered by sticking the treatment guidelines of my employer. I continued my study in work related injuries and began to examine the movement patterns and postures associated with the job tasks in detail attempting to understand why many times the patient's musculoskeletal symptoms quickly returned when returning to work. Around the same time, I was exposed to a method in which a therapist was using biofeedback to help employees relax specific muscles when sitting in front of a computer. At first, this seemed like a natural fit, so I investigated this biofeedback technique, but after much trial and failure, I retired the idea. The problem was that when the clients did not have the biofeedback sensors in place their poor postures and subsequent symptoms would return. This led me to do more in-depth research into the muscular changes that can take place due to the postures and movements one assumes or performs on a regular basis. I found that performing sEMG (Surface electromyography) studies on someone in a static position only gives a small amount of information. Most muscle imbalances will become more apparent with movement. In a search to discover more about these muscular adaptations I received training in performing dynamic surface electromyography (sEMG). I performed many studies while having the patients perform functional dynamic movements. This gave me a window into the body and demonstrated specific underlying muscle imbalances. Initially It appeared that all these muscle adaptations were the result of an injury. But many times, I found underlying muscle imbalances even when there was no injury. I also found these imbalances even when functionally movement patterns appeared normal, there was normal strength, and no pain. This meant that sometimes these underlying muscle patterns were present but were not significant enough to cause pain; like a small spark waiting to start a fire. Further study led me to determine that the muscle imbalances had a high correlation to the fiber composition of the muscle (slow twitch fibers vs. fast twitch fibers). I found that most muscle imbalances were due to increased tone in the tonic muscle fibers (slow twitch fibers) and decreased tone in the phasic muscle fibers (fast twitch fibers). It is well known that the CNS controls our movement patterns through a detailed neurological feedback loop using the mechanoreceptors within the muscles as the main sensory feedback mechanism. But the fact that I was learning that the fiber composition was a big factor I had to step back and re-examine the feedback loop associated with this finding. After further study I found that the fiber composition (tonic vs phasic) was intertwined with our distress reaction, demonstrating that these specific muscular adaptations were also driven and controlled through the ANS (Autonomic Nervous System).

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About this time, I was awarded a contract with the Intel Corporation to provide them with an injury prevention program. Most employees at Intel sit in front of a computer, so I began to study in more depth the postural and muscular adaptations associated with sitting and using a computer.

One of the significant findings I found was that sitting, even with proper posture, could still facilitate underlying muscle imbalances. This was caused by what I call the “default setting” of the muscle system. This "default setting" seems to be dominated by contraction of the flexor musculature, or more specifically the tonic musculature. Very simply our body’s innate protective muscular pattern is fetal posture position. It just happens that sitting, especially sitting in front of a computer all day is similar to the muscular patterns of fetal posture. We already know that if a muscle is in a shortened position for an extended period the mechanoreceptors can re-set in this shortened position sending improper signals to our CNS maintaining these underlying muscle imbalances. But now it was apparent that this “default” muscle mode was really an innate protective response controlled by the ANS. Since the Autonomic Nervous System (ANS) helps control our protective response and can override the CNS patterns, I began to further investigate the influence the ANS has on these underlying protective muscle patterns. I found that if the ANS was up regulated due to these tonic imbalances further exacerbating poor muscle function. So now I understood why my sEMG findings demonstrated increased tone in the tonic muscles. The distress reaction of the body is to contract and shorten the tonic muscle fibers.

I began to study treatment approaches that focused on de-regulating the ANS prior to performing corrective exercises. PRRT, Bowen Therapy, Feldenkrais and others. I used these techniques with some success. But this was only half of the equation. How do I lock these corrected patterns in? I then developed specific sequential proprioceptive specific treatment strategies to re-boot the muscles followed by sequential proprioceptive specific exercise strategies to re-build with proper muscle pattern organization. This course will detail the principles and techniques behind Muscle Pattern Re-Organization.

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Re-Boot Rebuild Restore

Re-Boot: All muscular movements are dictated by the CNS. For optimal movement, the CNS must get proper feedback and input from the mechanoreceptors within the muscles. These mechanoreceptors can become re-set due to many factors such as injury, poor posture, and poor body mechanics. Once re-set these mechanoreceptors will continually send improper signals to the CNS causing dysfunctional muscle firing patterns. These dysfunctional muscle firing patterns many times do not show up in our standard strength and functional assessments. If this was not bad enough, there is another factor. The influence of the ANS also has a strong hold on the mechanoreceptors further ingraining these dysfunctional muscle patterns. Using proprioceptive pattern specificity is a philosophy and technique that influences the mechanoreceptors during both hands-on treatments as well as during our corrective exercise approach, basically "hacking" the neurological system, we can clear these hidden networks of dysfunctional muscle patterns.
Thus, changing the structural conditions that re-set the nervous system and created the dysfunctional muscle patterns leading to chronic pain. We call this Muscle Pattern Re-Organization™. The result is generally a dramatic reduction in both the *experience* of pain and the *likelihood that it will return* because we dig beyond the external symptoms to root out spinal dysfunction at its source. There are several manual therapy approaches designed to normalize muscle tone by re-booting the mechanoreceptors to normalize CNS control. Strain-Counter Strain, Primal Reflex Release Technique, Bowen Therapy, and Motor Point Manipulation are just a few. I have advanced training in all the above techniques and have found them all to be effective for normalizing muscle tone. Muscle Pattern Re-Organization utilizes a percussion Thera-gun to perform these techniques much more effectively. But it is not just the tool. The tool increased the efficiency of the treatment but the knowledge to use the tool correctly makes the treatment effective. The MyoSequence technique you will learn in this class is a technique I developed which is a sequential proprioceptive specific technique designed to re-boot the threshold of the muscle mechanoreceptors efficiently and effectively by taking into consideration both ANS control and CNS control.

Re-Build: Some health care practitioners have the philosophy that the structure and alignment of our bones dictates our posture, alignment, and some believe our overall health. Posture and alignment are extremely important for optimal function, but it is the muscle system that is responsible for maintaining our posture and alignment. If you were to attempt to reconstruct the human skeleton by stacking the bones from the feet to the head the bones would fall to the floor. If you were to add tendons, ligaments, and fascia, the skeletal structure would still fail. Once the active component of the muscle system is added the structure has support. But even this may not be enough. It's not about just strength. The muscles must fire in proper sequence and proper degree so that our movements are executed optimally. Rebuilding muscle without first re-booting the mechanoreceptors will still lead to movement dysfunction. The Muscle Pattern Re-Organization technique incorporates sequential proprioceptive specific exercise strategies to rebuild proper muscle patterns and lock in the re-boot phase.

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Restore: Our goal is to restore optimal spinal motor control and to do so we must understand regional interdependence. We can re-boot the CNS and we can rebuild the muscles but if we do not do our best to eliminate the postural and biomechanical triggers, the symptoms will return. To restore optimal regional interdependence, you will learn to address the shoulders, neck, hips, and feet. All of which can contribute to a dysfunctional spine.

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Muscular Adaptations

Our body makes small incremental changes in structure and function based on the movements and postures we assume most often. Over time these small changes become large imbalances affecting functional movement leading to pain and dysfunction.

To accurately assess the body and provide proper corrective exercises and postural interventions we must understand how each part of the body affects the common postural deviations that lead to muscle imbalances. These imbalances commonly lead to altered biomechanics causing joint dysfunctions and ultimately damage to the underlying soft tissue structures. This is regional Interdependence and is a model that accounts for how the body performs as a functional unit or how one region can influence another. In other words, we cannot treat the back without treating other regions that affect the proprioceptive input and structural components of the spine. This manual will address this regional interdependence incorporating techniques to treat the common postural and movement faults of the neck, shoulders, hips, and lower extremities. Since we now know that the CNS controls and maintains these imbalances the hard part is implementing interventions which address the underlying control of the CNS and ANS. But don't worry we have done it for you. Functional Muscle Therapy has taken it to the next level and created interventions specifically designed to re-boot the muscle system using manual therapy techniques then provides exercises and postural instruction which utilize proprioceptive pattern specific input to rebuild optimal muscle pattern organization locking the correct patterns into our internal hard drives, the CNS and ANS.

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Chapter 2

Principles of Muscle Pattern Re-Organization

Muscle Pattern Re-Organization
Understanding Postural/Muscle Adaptations
Muscle Confusion vs Cooperation
The Influence of the CNS
The influence of the ANS

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Muscle Pattern Re-Organization

Muscle Pattern Re-Organization is based on a somewhat forgotten principle. Optimize motor control through the facilitation and optimization of Central Nervous System control.

It's not just about core strength! Core muscles must have sufficient strength and endurance to satisfy the demands of segmental spinal motor control, but the efficacy of the muscle system is dependent on its controller, the central nervous system (CNS).

The CNS must continually interpret the status of stability and movement, plan mechanisms to overcome predictable challenges and rapidly initiate activity in response to unexpected challenges. It must interpret the afferent input from peripheral mechanoreceptors and other sensory systems, consider this input and the impending requirements and then generate a coordinated response of the trunk muscles so that the muscle activity occurs in proper sequence and proper degree so that the action is executed accurately and optimally.

Muscle Pattern Re-Organization postulates that to achieve the coordinated muscle control essential for optimizing long term spinal health change is dependent on proper input from higher centers of the CNS. Functional Muscle Therapy achieves Muscle Pattern Re-Organization though proprioceptive specificity throughout the treatment and rehab protocol and our techniques are designed to facilitate and optimize afferent input from peripheral mechanoreceptors and the other sensory systems responsible for this control.

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Theories and Principles

1. Facilitating Healing of Damaged Tissue

The Total Spinal Fitness Model is based on The Physical Components of Health and Healing.
Healing is dependent on suppling proper nutrition to the damaged tissue.
Although we are rehab specialists our first job consists of facilitating the healing of injured tissue. Collagen is the main structural protein that forms the connective tissues in the body including the injuries we treat on a regular basis the tendons, ligaments, and the concentric annular fibers of the spinal discs.
Supplying the body with the proper nutritional needs to repair the damaged cells is essential for optimal healing. I will define nutritional healing as: "A natural chemical or substance which aids in cellular metabolism and is essential for us to maintain healthy tissue." By this definition it seems naive to expect to heal from an injury or prevent potential injuries without the proper nutrient substances the body needs for the ongoing process of cellular repair and regeneration. When the body is attempting to replace damaged cells with new healthy cells proper nutrition is a necessity. Most collagen tissues get their nutrients directly through the capillary system the blood carries the nutrients directly to the tissue. Unfortunately, the collagen of the spinal discs and the spinal joints have very little direct blood supply. These collagen fibers need continual motion to provide the fluid transfer which provides their hydration and nutrition. The Total Spinal Fitness System protocol was designed to facilitate gentle segmental motion to the spinal discs and joints to provide the fluid exchange and nutrition needed to maintain healthy joints and discs.

Counteracting the Daily Compression Forces on our Spinal Discs

Treatments are performed in the optimal unloaded position with the option to utilize a decompression strap.

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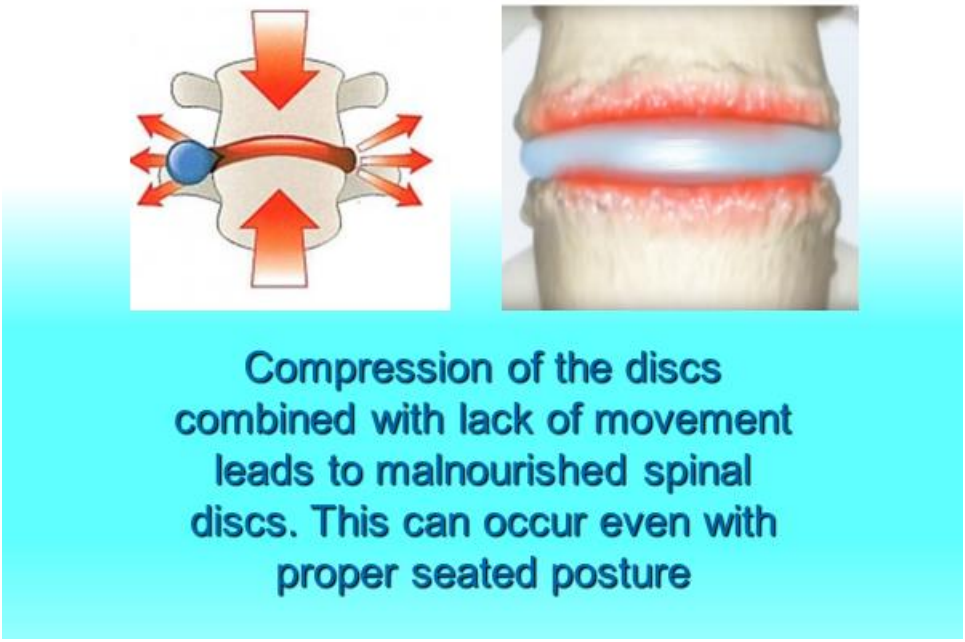
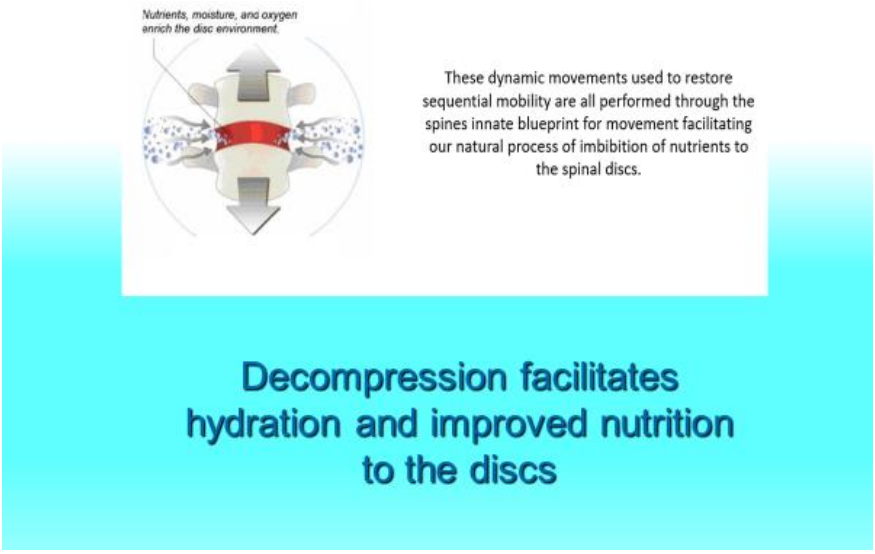


We are all living in a modern computer environment in which prolonged sitting is very common. We know that sitting causes increased compression on the discs. However, even with proper posture the spine remains in a static position for prolonged periods of time limiting fluid transfer in the joints and lumbar discs. The spinal joints and spinal discs get their nutrition through this fluid transfer and fluid transfer can only take place with segmental spinal movement. The Total Spinal Fitness System protocol is the only device that allows for the natural movements of the spine while in the unloaded position of decompression. Allowing for natural imbibition of fluids and nutrients into the discs and joints.

The Total Spinal Fitness System protocol recognizes the importance of early action to re-establish normal functional movements of the spine, in particular, the disc is of the utmost importance.



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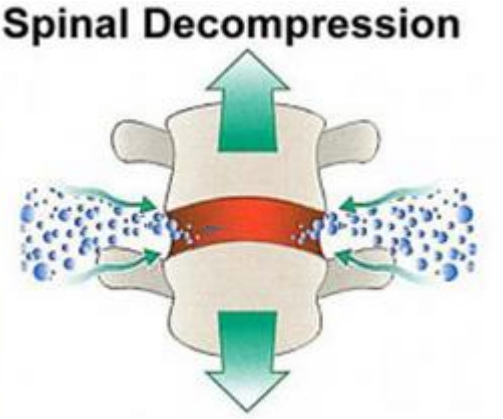
Facilitating Improved Nutrition to the Spinal Discs and Joints



Think of your spinal discs as a sponge surrounded by water. If your discs remain compressed and immobile for prolonged periods of time the fluid is pushed out. It is during the decompression, or releasing the sponge, that the fluids are drawn into the sponge. Our spinal discs work in a similar manner. Our spines can handle compression forces if they are routinely followed by decompression movements.

The joints of the spine are also dependent upon motion to remain healthy, so we are also providing increased nutrition to the spinal joints. When a joint moves the inner lining of the joint capsule is triggered to release hyaluronic acid. Hyaluronic acid is essential to imbibe water into the joints and is responsible for the resilience and health of the articular cartilage.

Therefore, during our everyday active spinal movements our spinal joints and our spinal discs will continually draw in fluids and remain hydrated and healthy.

The Total Spinal Fitness System recognizes the importance of early action to re-establish normal functional movements of the spine, in particular, the disc is of utmost importance.

The Total Spinal Fitness Protocol places the spine in an unloaded position, this way we can initiate these movements early, safely, and specifically.

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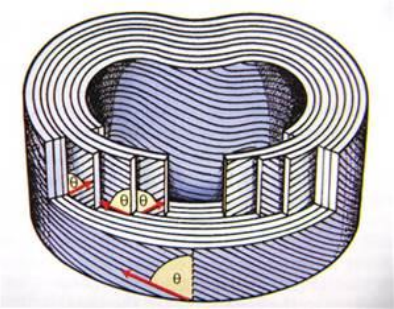
Facilitating Collagen Healing

Incorporating pelvic and lumbar rotation is especially important for stimulation of collagen healing and strength of the annulus fibrosis. In addition to proper nutrition, repair and long-term health of collagen tissues also depends on providing proper loads to the collagen fibers. Just as our bones would not rebuild properly without compression forces, our collagen fibers are stimulated to repair and remain strong with tensile loads in line with the collagen fibers.



Collagen Healing
Inflammation (Duration = Days)
Proliferation (Duration = Weeks)
Remodeling (Duration = 1 Year)

This demonstrates the importance of an effective continuum of care for up to a year to facilitate proper healing of the discs.

The Total Spinal Fitness System protocol was designed to incorporate gentle tensile forces in line with the collagen tissue of the lumbar discs to stimulate and facilitate proper repair and remodeling of the fibers of the annulus fibrosis.

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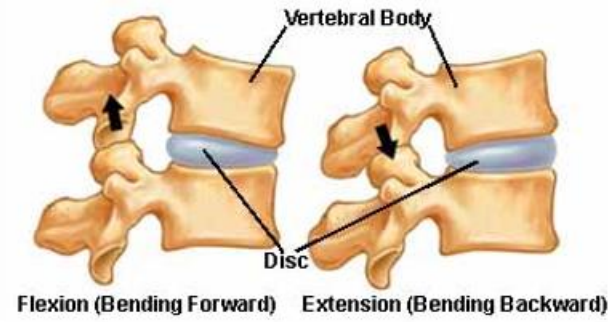
2. Restoring Optimal Segmental Lumbar Spine Mobility

Each lumbar Segment Should Contribute Motion for Optimal Function



The Total Spinal Fitness protocol can safely and effectively restore segmental mobility.

Our System is Based on Clinically Validated Mobilization Approaches

To name a few, Kaltenborn, Maitland, Paris, and McKenzie have all developed effective techniques to mobilize and normalize spinal segmental movement and their treatment techniques have been clinically validated.

The Total Spinal Fitness System was developed based on these concepts. The goal of spinal mobilization is to free up restricted regions of the spine and we also strive for and provides a method to maintain the mobility achieved through these techniques. The goal of spinal mobilization is to free up restricted regions of the spine but improving mobility without restoring segmental motor control will still lead to dysfunction, so most importantly The Total Spinal Fitness system is the only device that provides specialized deep segmental core strengthening to optimize segmental motor control lending to long term spinal health.

Total Spinal Fitness is based is a system that pulls together many treatment approaches and we feel enhances these clinically accepted approaches. Here are a few examples of how our system will enhance and complement many of the most popular treatment approaches.

Enhance the McKenzie Method

The Active Decompression System is a comprehensive approach to the treatment of spinal disorders using many of the same sound clinical principles validated by other current approaches such as the McKenzie Method. The McKenzie Method is one of the most studied and validated treatment approaches. The McKenzie method understands that to improve health to the spine we must incorporate specific segmental movements. The Total Spinal Fitness System will significantly enhance the mechanical effects intended in the McKenzie method.

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Enhance the Kaltenborn Technique

Kaltenborn Techniques use a combination of traction and mobilization to reduce pain and mobilize hypomobile joints.

The Total Spinal Fitness System is the only device that utilizes lumbar traction when performing spinal mobilization techniques. The Kaltenborn wedge can also be utilized with the Total Spinal Fitness System.

Enhance the Maitland approach.

Maitland's grades of joint mobilization are performed as oscillations.

Although Maitland's mobilizations are passive the Total Spinal Fitness System Protocol with the use of the different size mobilization pads while having the patients perform repetitive movements, can mimic some of the Maitland oscillations and mobilizations.

Enhance the Paris technique.

His primary teachings are focused on restoring joint mobility. His techniques focus on finding where accessory joint mobility is limited, and then restoring that mobility with precise joint specific mobilization techniques.

The Total Spinal Fitness System protocol also follows the principles of the Paris technique.

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Restoring spinal mobility has always been a key treatment philosophy among Physical Therapists. Paris, Kaltenborn, McKenzie, Grimsby, and Maitland are just a few of the widely used and effective manual therapy methods. Although these techniques are effective, they are usually performed with the patient in prone and the mobilizations are somewhat restricted due to the force going into the body with the table below. With the *Total Spinal Fitness System Protocol* and the skilled placement of mobilization pads spinal mobilization techniques can be performed not only in a position of decompression but without the restriction of the body tissues against the table below.

(Extension Oriented Treatment Approaches) are widely used and can be highly effective. Many of these techniques are performed by the patient in prone or standing making it difficult to have the patient truly relax their muscle and passively extend the spine. The tonic action of the Psoas muscle can also interfere with the movement of the spine during these maneuvers and the maneuvers to not necessarily restore motions at all segments. When performing prone extension maneuvers many times the patients continue to hinge from the already overused segments only. Utilizing the decompression band and the mobilization pads of the Total Spinal Fitness protocol EOTA's can truly be performed in a passive manner without any interference from the Psoas muscle and specifically restore extension movement targeting the restricted segments.

> With the proper size and placement of the extension pads the Total Spinal Fitness protocol facilitates specific segmental lumbar extension with a goal of improving and normalizing the segmental movement of all the lumbar vertebrae. This will lead to improved segmental motor control and significantly decrease the force and stress on the segment that was damaged.

Supporting Literature for Spinal Mobilization

The mechanical effects of joint mobilization relate to the restoration of normal joint mobility or range of motion. This includes flexibility and mobility of capsular and other soft tissue structures such as ligaments and tendons. Following injury and immobilization, soft tissues can become shortened and limit overall joint mobility. Another theory of mechanical effect is the releasing or freeing of the facet joint meniscoid entrapment. A meniscoid entrapment may include a locking caused by entrapment of a facet joint meniscoid in a groove formed in the articular cartilage or by a meniscus piece that has broken free and formed a loose body that is entrapped (Lewitt, 1985). These meniscoids can become extremely painful sources of dysfunction. Fortunately, either gapping or an isometric movement that pulls the facet laterally can theoretically dislodge the impingement; the result can be immediate pain relief and improvement of joint motion. Current evidence supports only transient biomechanical effects on studies quantifying motion (Colloca, Keller, Harrison, Moore, Gunzburg, and Harrison, 2006; Coppieters and Alshami, 2007; Coppieters and Butler, 2007; Gal, Herzog, Kawchuk, Conway, and Zhang, 1997)but not a lasting positional change (Hsieh, Vicenzino, Yang, Hu, and Yang, 2002; Tullberg, Blomberg, Branth, and

Johnsson, 1998).Neurophysiological and psychological effects should therefore be strongly considered.
Applications of joint mobilizations and manipulation have been reported to create both local and distal neurophysiological effects (Bialosky, Bishop, and Bialosky, 2009; Bishop, Beneciuk, and George, 2011; Coranoda, Gay, and Bialosky, 2012; George, Bishop, and Bialosky, 2006). These effects may be especially enhanced when using the spine as the region of mobilization or manipulation application. Spinal soft tissues are highly innervated and may provide a large degree of **afferent** input into the central nervous system (Groen, Baljet, and Drukker, 1990). This input can come from multiple sources such as type I and II mechanoreceptors and free nerve endings found in cervical spine facet joints and muscle spindles of the cervical spine. Similar mechanisms might be seen in the remainder of the spine, but the number of nerve endings may be lower and less consistent in lower levels of the spine (McLain and Pickar, 1998). Movement such as mobilization or manipulation will fire these receptors and provide input to the central nervous system. These nerve receptors terminate in the spinal cord synapsing in the ventral and dorsal horn to signal proprioceptive and nociceptive information (Bolton, 1998).

Animal and human models have shown that the periaqueductal gray area of the midbrain is key for control of mediation of endogenous analgesia (Cannon, Prieto, and Lee, 1982; Hosobuchi, Adams, and Linchitz 1977; Reynolds, 1969). The periaqueductal gray area is in coordination with a complex network of systems including the nociceptive system, the autonomic nervous system, and the motor system. It has also been shown that type I and II mechanoreceptors from joints, muscles, and tendons project to the periaqueductal gray area (Yezierski, 1991). Evidence via postmanipulation sympathetic response combined with analgesia in symptomatic and asymptomatic subjects suggests a neurophysiologic response to spinal manipulation via mechanoreceptors (Wright, 1995). These effects may lie in the stimulation of the descending pain-inhibitory system of the central nervous system from midbrain to spinal cord.

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Assessing Spinal Mobility

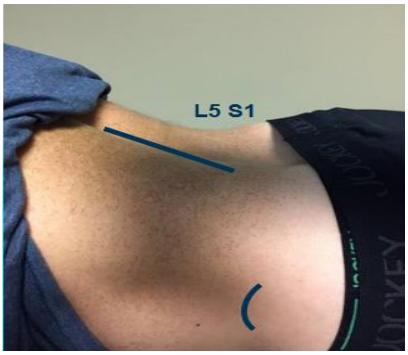
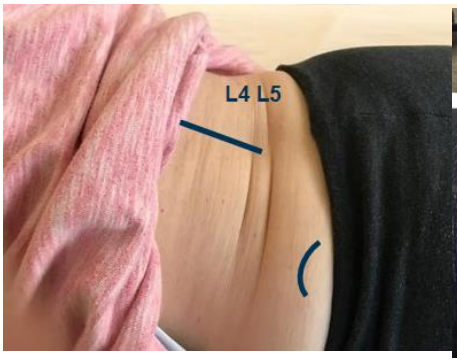


Fig 1.



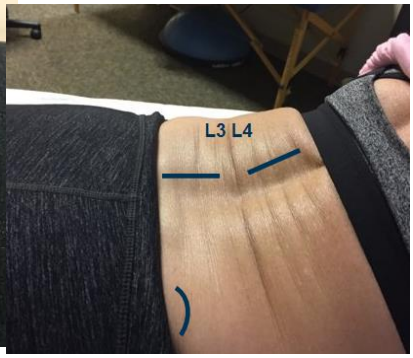


Fig 2.

Not to take away from our detailed assessments for spinal dysfunctions but assessing spinal mobility can be as simple as asking the patient to perform prone on elbows maneuver. Many times, you will see a crease in the skin and the most mobile segment. The most common spinal mobility dysfunctions are in Fig 1 and 2. The majority of disc injures are at the L4-L5 and L5- S1 segments. The spinal segments above these segments supply relatively little movement placing the hinge of the motion at the L4-L5 and L5-S1 segments leading to increased wear and tear at this specific segments. Fig 3 shows a patient with a less common dysfunction with increased motion at the L3-L4 segment.

Fig 3.

The Total Spinal Fitness protocol using proper placement of the specialized extension pads can specifically improve mobility at the restricted regions, and all in the safe position of decompression with the goal of achieving contribution of motion at all segments of the lumbar spine.

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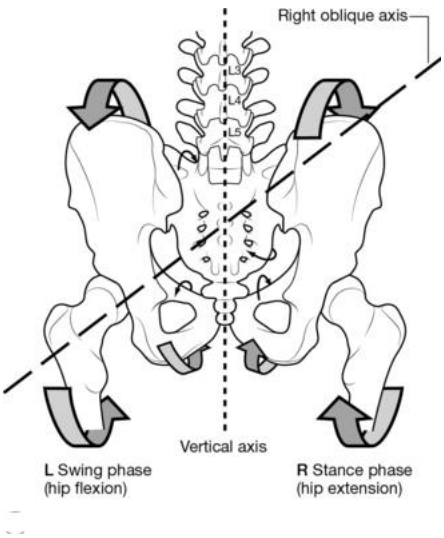
Restoring Functional Lumbo-Pelvic Rotation



With specific placement of mobilization pads along the oblique axis of the pelvis we can restore segmental movement through the natural movements that the spine was designed to move through. We used our most natural and functional motion of gait as our guide. As the left limb swings forward, the left side of the pelvis also moves posteriorly so that the pelvis rotates to the right. During stance for the right limb, the pelvis then rotates anteriorly. This causes the pelvis to rotate to the right along the right oblique axis. During this functional gait motion the spine also slightly rotates and side bends segmentally.

Using the pelvic/lumbar rotational exercise, we can simulate this pelvic movement in the unloaded position restoring this natural pelvic and lower lumbar synergy.

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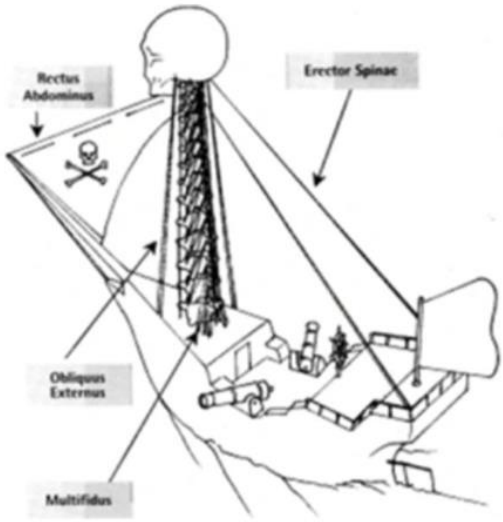
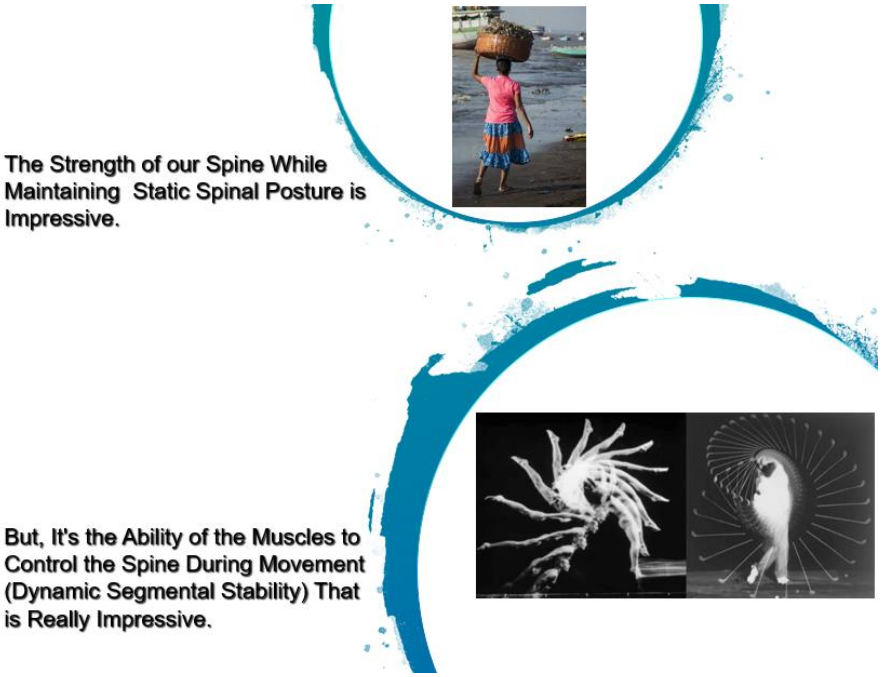
3. Optimizing Segmental Spinal Motor Control

Structural Spinal Stability



Second to protecting our spinal cord the main function of our spine is to provide us with a centralized supportive structure. It is like the center pole of a large circus tent or the mast of a ship. But this is a static model and although the spines' ability to statically support our body is impressive, the most phenomenal attribute and function of our spine is that it can maintain our structural support while in motion.

Although most of us do not perform athletic activities that demand the type of spinal movement seen in the lower picture to the right, the fact remains that our spines are designed to move.



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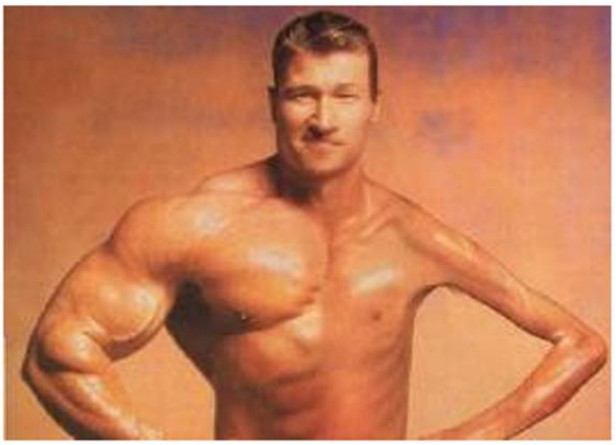
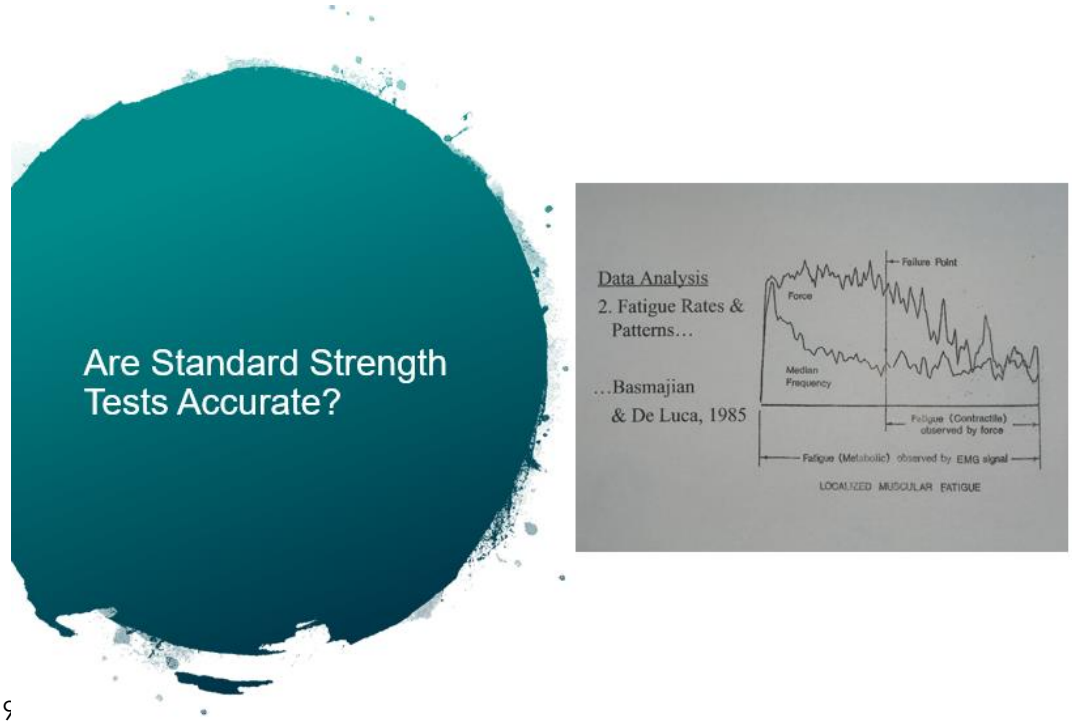
Why Muscle Pattern Re-Organization and Not Just Conventional Core Strengthening?

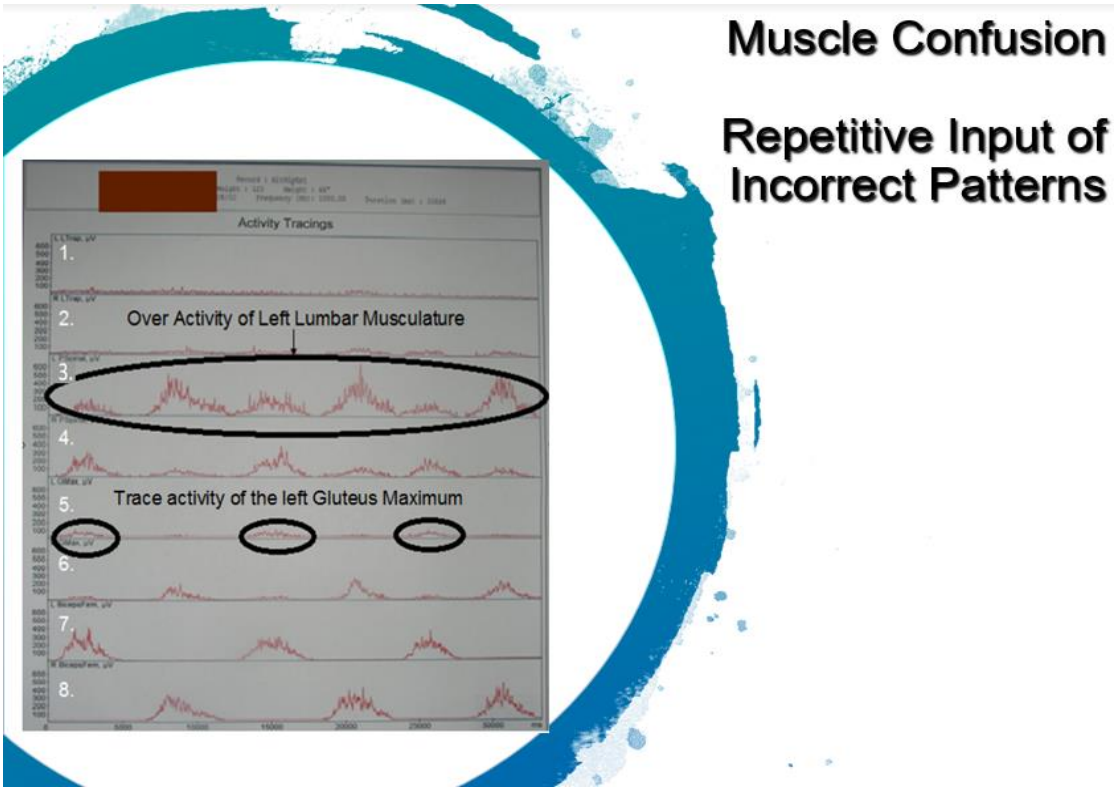
You can go wrong with just strong. Strengthening the core muscles with an underlying muscle imbalance will lead to further dysfunction. These underlying muscle imbalances are many times hidden and will not show up on standard strength tests and may not even show up with functional movement assessments.



The following study by Basmajian & De Luca 1985, demonstrates that "Standard strength measurements are not always a true indicator of muscle function". This study shows that even though a strength task is being completed, the underlying muscle can be fatiguing without disrupting the task. The top line indicates what is being observed by the practitioner. The vertical line is the point at which the practitioner can see that the patient is failing to maintain the strength task. Using sEMG the bottom line indicates that the muscle began to fail almost immediately. So, you can see that your standard strength tests and even functional movement assessments can be misleading.



Muscle Confusion



This is an sEMG study performed on a healthy 32-year-old female. She was a Certified Pilates Instructor and I asked her to do a study with me to get some normative data. This was a real epiphany as the results were shocking. Her sEMG assessment demonstrated a significant hidden underlying muscle imbalance. An 8 lead sEMG study was done with the patient prone. Leads were placed on the left and right upper trapezius; the left and right lumbar paraspinals; the left and right gluteus maximus; the left and right biceps femoris. The patient was asked to alternate right and left hip extension in the prone position starting with the left hip. As noted in the 5th row when asked to extend the left hip there is little muscle activity in the left gluteus muscle. When asked to extend the right hip there is also little muscle activity, as noted in row 6, but more activity than the left gluteus muscle. The major compensation takes place in rows 3 and 4 demonstrating a significant increase in muscle activity in the lumbar paraspinals. Rows 7 and 8 also demonstrate a compensatory increase in muscle activity of the hamstrings bilaterally. She presented with normal strength, normal flexibility, great posture, and no functional movement deficits. These results suggest that the body can easily accommodate for underlying muscle imbalances through increased muscle activity in the synergists muscle groups. In this case the sEMG demonstrated very clearly that her left lumbar paraspinal musculature was compensating the greatest. This also correlated to her symptoms, which were complaints of left low back pain at the time of the assessment. This was a great example of how we cannot rely on some of our standard muscle strength tests. By understanding the CNS influence on muscle re-patterning, as you will learn in this course, you will be able to easily treat this underlying dysfunction. Through our sequential proprioceptive specific treatment approach these underlying hidden muscle imbalances can be corrected because we re-boot the entire system.

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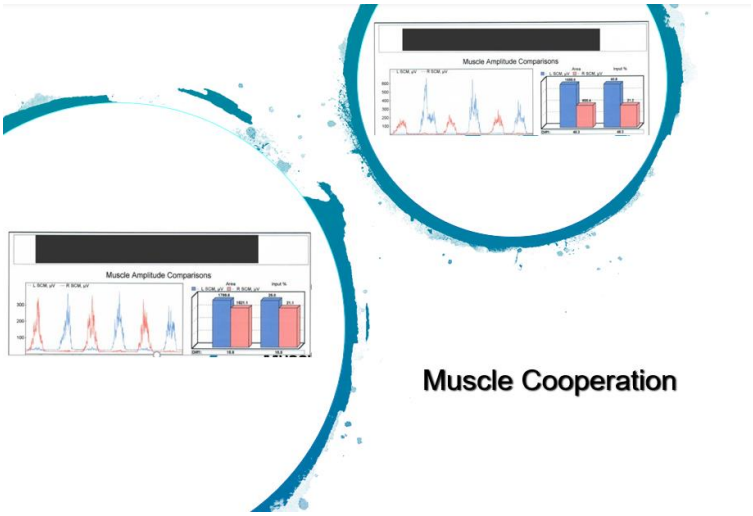
Muscle Cooperation

There is a popular workout called PX90 and they claim that their program is based on muscle confusion. I am not sure what they mean by this as I consider the previous sEMG assessment an example of muscle confusion which leads to spinal dysfunction. Muscle Pattern Re-Organization strives for what I call muscle cooperation.

To better understand how muscle imbalances occur lets first, let us look at how single muscles work. A single muscle can only perform one function, contraction. So, it would seem a muscle can only have one of two problems. It is contracted (increased tone) when it should be relaxed, or it is relaxed (decreased tone) when it should be contracted. Since we now know that a muscle can only have one of two problems, muscle imbalances should be easy to address. The problem is, **no muscle acts alone!!** It is always a team event. Even the simplest of movements such as bending a finger consists of several muscles stabilizing (synergists), several muscles relaxing (reciprocal inhibition), and one or two muscles controlling the main action (prime movers). When this team of muscles cooperates, we have efficient mechanics and can achieve maximum function. Sherrington's laws of reciprocal inhibition and irradiation demonstrate this team event. Sherrington's laws basically state that any given muscle needs help from the surrounding muscles. When this all occurs with correct muscle pattern organization, I call this muscle cooperation.

"We have muscle cooperation when all components of muscle contractions follow in proper sequence and degree so that the action is executed accurately and efficiently."

The following is a study demonstrating muscle activity before and after treatment for imbalance on the SCM musculature. The top right picture demonstrates a moderate cervical muscle imbalance with the left SCM (blue) muscle activity significantly higher than the activity of the right SCM (red).



The picture to the left was a subsequent sEMG study was done following Muscle Pattern Re-Organization treatments and demonstrates the effectiveness of proprioceptive specific techniques.

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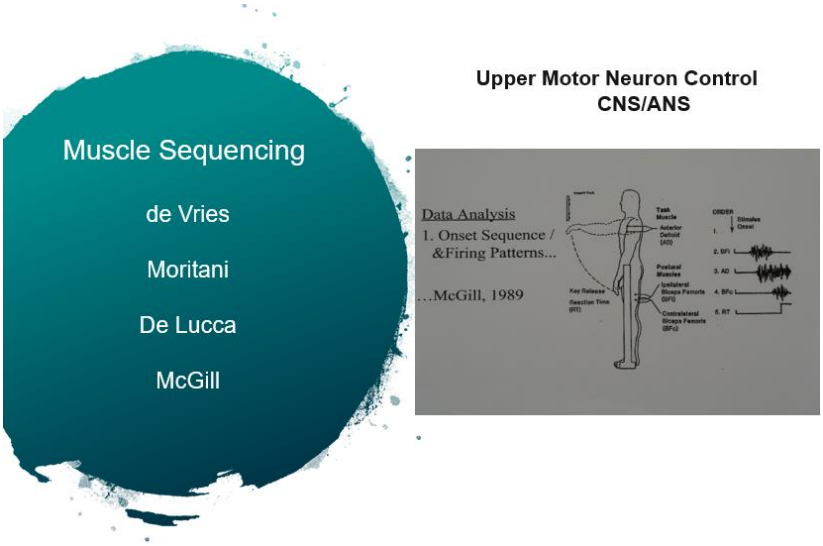
The Role of the Central Nervous System in Muscle Pattern Organization

Upper Motor Neuron Control

Muscle Sequencing is well documented in the literature and is controlled by the CNS.



This study by McGill demonstrates "muscle cooperation" and proper muscle sequencing or optimal muscle pattern organization. The body learns from an early age that when the arm is raised forward the body's weight shifts forward. This study demonstrates that the BFI (ipsilateral biceps femoris) contracted a split second before the AD (anterior deltoid). Since the deltoid lifts the shoulder, one would think that the first muscle to contract would be the deltoid. But the CNS has learned to contract the hamstring muscle a split second prior to lifting the arm as to not lose balance. This is just one example of "muscle cooperation" demonstrating proper sequence of muscle activity to achieve optimal efficient biomechanics. This study also demonstrates the intricate CNS control over our muscle system.

CNS initiates a sequence of muscle activity involving the limb and trunk muscles in advance of limb movements to prepare the body for the predictable disturbance to stability from the reactive forces caused by movement. This sequence of responses is feedforward, that is, it is preplanned by the CNS and occurs in advance of the movement.

The CNS manages and controls our movements and postures on a regular basis through specific feedback from tiny receptors in the joints and muscles. As previously discussed, if the muscles cooperate then joint biomechanics are optimized. Remember our CNS is pattern oriented or in simple terms is a "creature of habit". Some call this muscle memory. The previous study by McGill in which the ipsilateral hamstring muscle contracts, just with the thought of shoulder flexion, demonstrates this is CNS memory not muscle memory. The CNS, not the muscle, remembered to stabilize the body before

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performing the actual movement. Unfortunately, once the threshold or our proprioceptors are re set our movements and postures will continually send improper feedback to the CNS. This is not only due to the re-set of the mechanoreceptors within our muscles but also due to the ANS up regulation process. Let us again use the example of the study by McGill. Let's say there is decreased tone in the hamstring due to an old injury, now every time shoulder flexion is performed the body will have to use a different muscle to stabilize the body, creating a sequence of improper muscle actions. This demonstrates the regional interdependence of different regions of the body and how increased or decreased tone in a single muscle can cause pain and dysfunction in another region of the body.

De Vries performed EMG studies that also demonstrated the impact of sustained postures and movements regarding CNS activity controlling muscle patterns.

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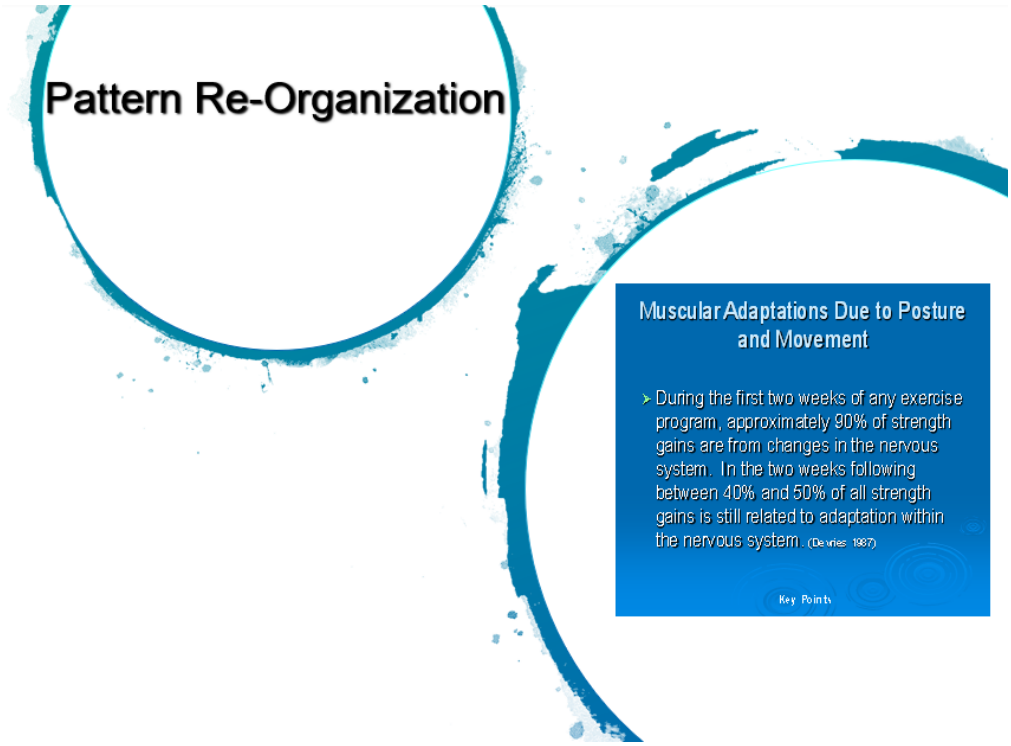
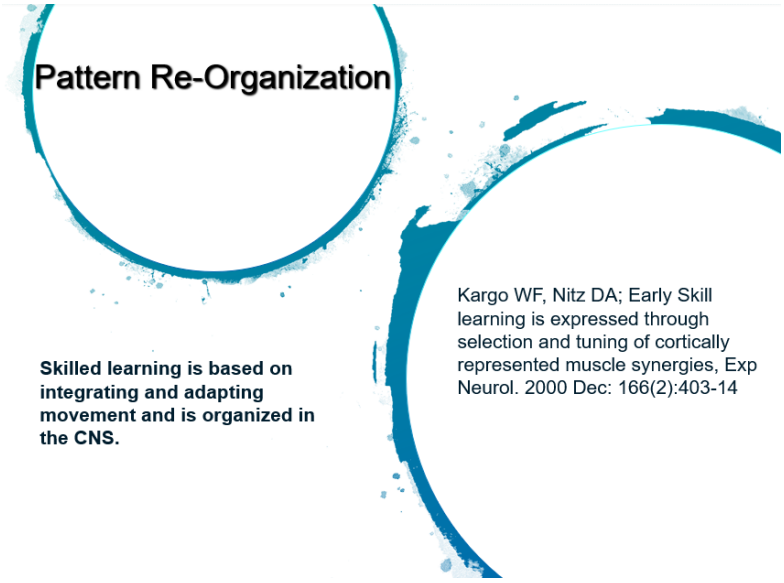


De Vries proved that the CNS would adapt by increasing activity to specific muscle groups that are used more often, which further demonstrated that habitual and repetitive postures and movement patterns can create new *CNS* driven muscle patterns. Taking into consideration the innate protective flexion (tonic) response of the body and this study by De Vries, you can now see that this can cause muscle pattern re-organization and the CNS can maintain this dysfunctional muscle pattern.

The studies further demonstrate Muscle Pattern Re-Organization organized in the CNS based on Upper Motor Neuron Control.



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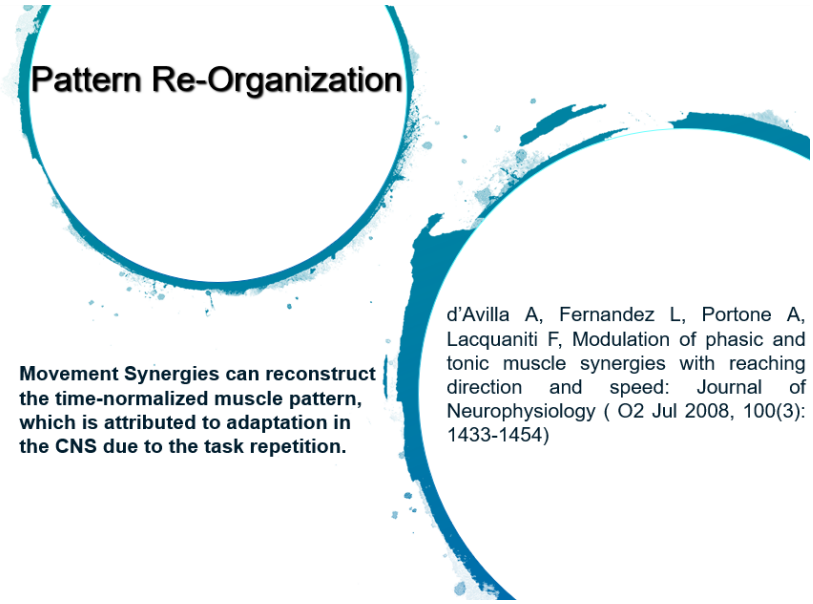
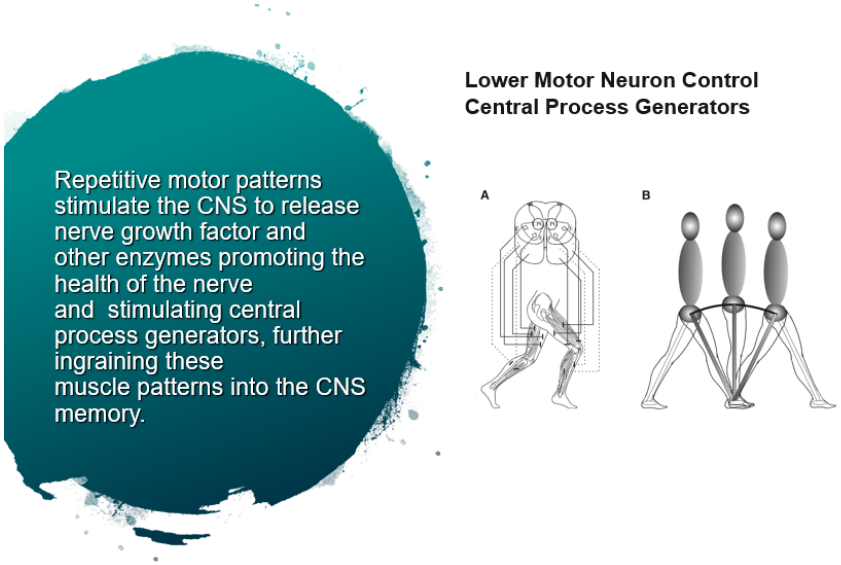


Lower Motor Neuron Control

Rhythmic motor patterns comprise a large part of patterned behavior. They are also complex and, by definition, repetitive. These patterns stimulate Central pattern Generators (CPG's). Central Pattern Generators (CPG's) are collections of sensory and motor nerves and inter neurons that work together to run basic movement patterns. This repetitive activation of motor neurons releases nerve growth factor (NGF) and other enzymes promoting Na+, K+ and Ca+ channel integrity. Protein building to improve nerve health NGF migrates up and down the nerve It can take up to two weeks for NGF to reach the spinal cord. These are lower motor neuron loops that also contribute to the pattern re-organization and further validate that repetitive motor patterns will re-pattern muscle sequencing.



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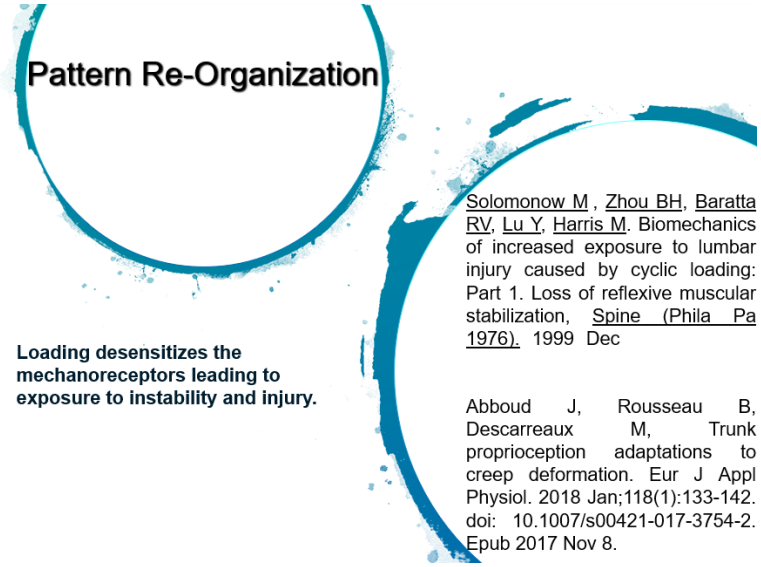
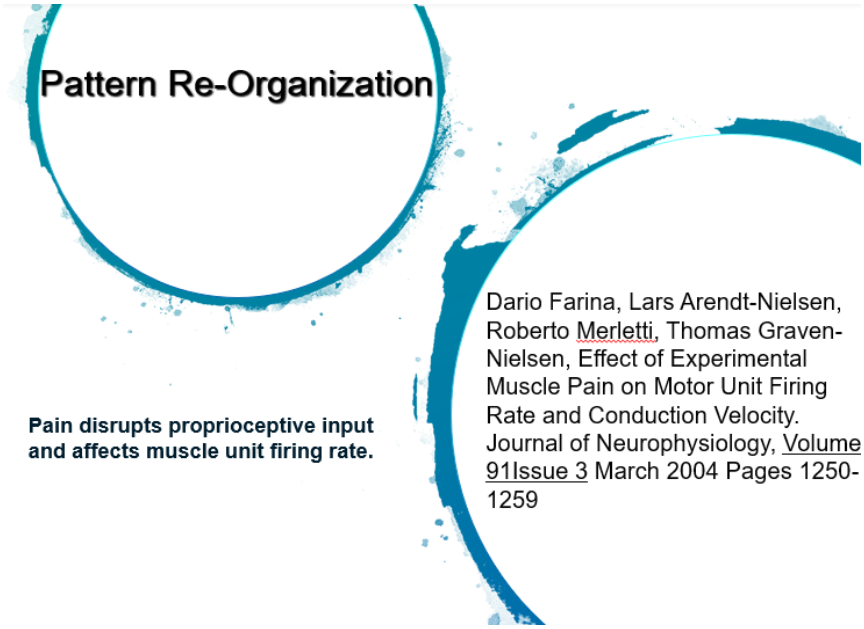
Cyclic Loading

Other factors are also taken into consideration when normalizing proprioceptive input and optimizing lumbar motor control including cyclic loading to the lumbar discs and pain.

In these studies, it was determined that cyclic loading causes a creep in the lumbar tissues diminishing proprioceptive input leading to exposure to instability and injury. For this reason, Functional Muscle Therapy incorporates unloading of the spine.



Pain



Pain also disrupts proprioceptive input and affects muscle unit firing rate which leads to muscle imbalances and dysfunction. Functional Muscle Therapy takes this into consideration providing unloading do decrease and always performs strengthening exercises within the pain free range.

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Muscle Pattern Re-Organization

These factors related to the control the CNS has over our muscles are innate and serve a great purpose. Unfortunately, these innate mechanisms which are essential and extremely beneficial can work against us. But just as the repetitive input of improper CNS input can drive us toward muscle confusion and spinal dysfunction, repetitive input of correct proprioceptive input can properly re-organize our muscle function. This demonstrates the importance of sequential proprioceptive specific treatment strategies. Functional Muscle Therapy has taken these CNS mechanisms into consideration and has developed proprioceptive specific treatment interventions to re-boot the mechanoreceptors normalizing input into the CNS. This is the re-boot phase of treatment. Beginning to rebuild muscle without re setting the threshold position of the mechanoreceptors would be like building a structure on an uneven foundation.

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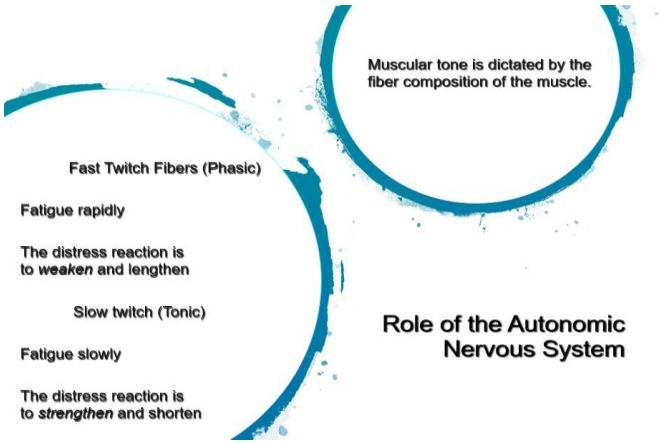
The Role of the Autonomic Nervous System (ANS)
ANS Influence on Muscle Re-Patterning

Since we are treating injuries, it is important to understand that the ANS controls our self-splinting mechanism following an injury. This can upregulate the ANS holding our ANS in distress reaction mode which overrides the central nervous systems proper muscle pattern sequences. The distress reaction of the ANS (protective response) is to strengthen and shorted the tonic musculature. This tonic protective response also correlates with our body's innate protective muscular pattern, fetal (flexion) posture. The McGill study demonstrates CNS memory. This innate protective response demonstrates our "default" muscle memory. In absence of CNS control the muscles of the body tend toward flexion (fetal posture) We see this with spinal cord injuries and with stroke patients. In these cases, the CNS is cut off from the muscle system and the body tends toward fetal (flexion) posture. I call this the "default setting" of the muscles. In addition to the innate tonic protective response of the ANS, the muscles themselves are biased toward flexion patterns. Unfortunately, these ANS driven patterns influenced by fiber composition, correlate with the postures and movements associated with our modern environment from using a computer for up to 8 hours a day, to driving a car, to sitting and watching TV. It just happens that sitting is a bias of the body toward shortening of the tonic musculature and stretching of the phasic musculature continually sending feedback to the CNS and muscles to facilitate both the protective response and "default" flexion mode of the muscles. It is no wonder pain management is one of the fastest growing fields in physical medicine. First, it is important to discern between muscle tension (increased tone) and a tensioned muscle (decreased tone). Muscle tone is the state of contraction of any given muscle. This muscle tone is controlled by the CNS and although the muscle mechanoreceptors are the main feedback loop to the CNS the CNS can be overridden by the autonomic nervous systems protective response further affecting dysfunctional muscle re-patterning.

We have two distinct types of fiber composition in skeletal muscle: tonic (slow twitch fibers) and phasic (fast twitch fibers). Since the innate distress reaction of the ANS is to shorten and contract the tonic musculature, the tonic muscles are usually the muscles with increased tone (muscle tension). I found this to be true when performing my sEMG movement studies as the tonic musculature frequently demonstrated increased tone. Understanding which muscles tonic and which muscles are phasic can help you to determine which muscle is tense (increased tone) and which muscles are inhibited (decreased tone). This manual will list the tonic and phasic musculature associated with the most common muscular imbalances related to the influences of our modern environment.



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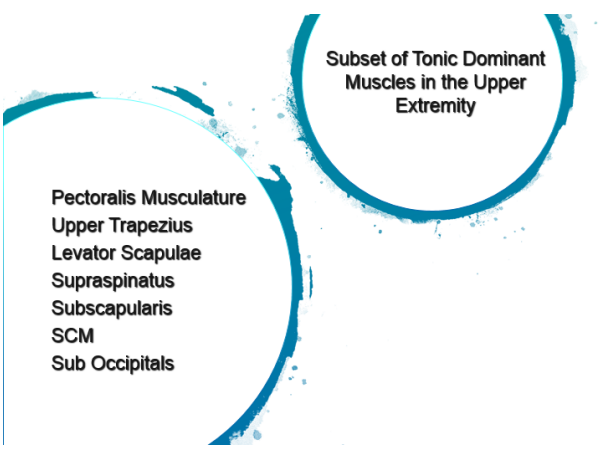
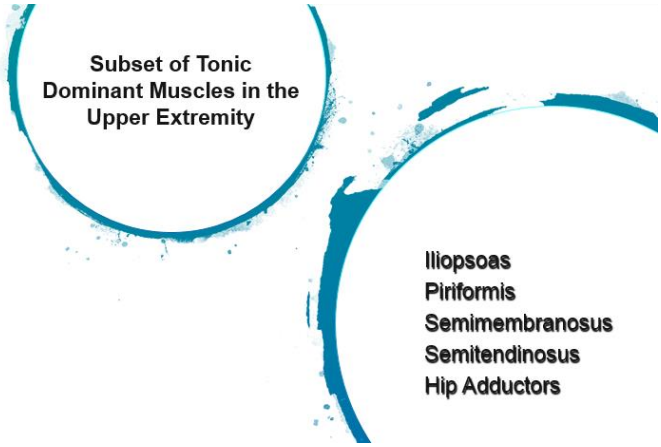
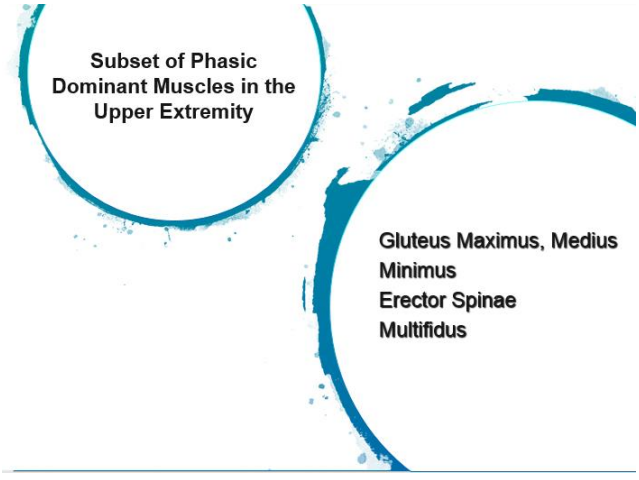
The Tonic and Phasic Subsets

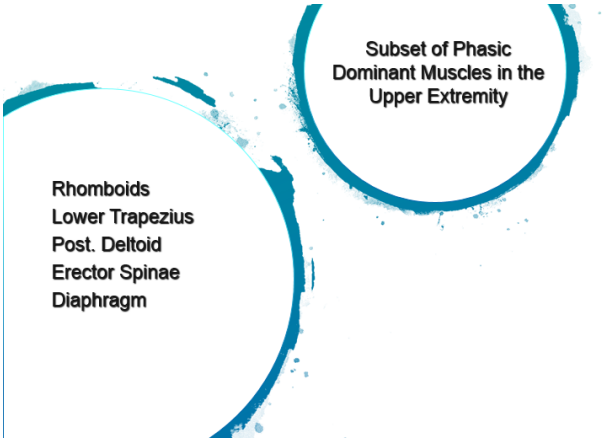
Below are the major subsets of tonic dominant musculature affecting which drive us toward the “default setting” leading to postural and musculature dysfunction. Since these muscles are the major players in our ANS protective response post injury as well as during times of stress, Functional Muscle Therapy addresses these muscles first to de regulate the ANS during the re boot phase.





Below are the major subsets of phasic musculature that are inhibited when the tonic patterns above are dominated by ANS control. These muscles are facilitated first during the rebuild phase of treatment.





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The Influence of the Endocrine System

The Autonomic Nervous System also has an impact on the Endocrine System. When the ANS is upregulated, the Endocrine System secretes norepinephrine. Norepinephrine is a substance that decreases blood flow to certain areas and increases blood flow to other regions. But norepinephrine plays a dual role. Norepinephrine can also act as a neurotransmitter when the ANS is upregulated. Deregulating the ANS will be discussed further in the regional interdependence section.

These ANS factors like the CNS factors are innate and serve a great purpose. But left unaddressed they can also work against us.

I hope you can see the process better now.

1. Rebooting the mechanoreceptors within the muscles to normalize sensory feedback to the CNS is crucial to restore proper muscle pattern organization.
2. Rebooting the CNS while the ANS is overriding it will lead back to dysfunctional muscle pattern re-organization.

Functional Muscle Therapy's Proprioceptive Specific Techniques are sequential and focus on de-regulating the ANS first.

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Chapter 2

Muscle Pattern Re-Organization of the Core

Alignment
What is Our True Core?
Deep Core
Intermediate Core
Outer Core
Restoring Lumbo/Pelvic Biomechanics

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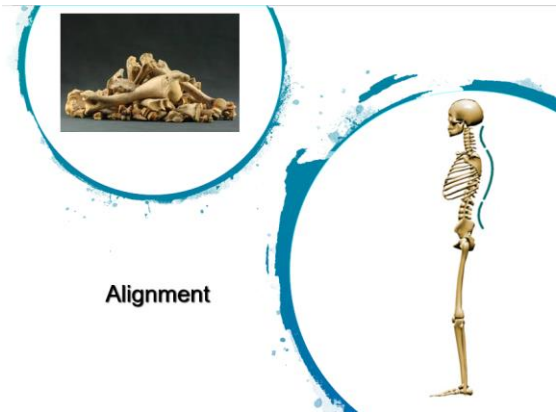
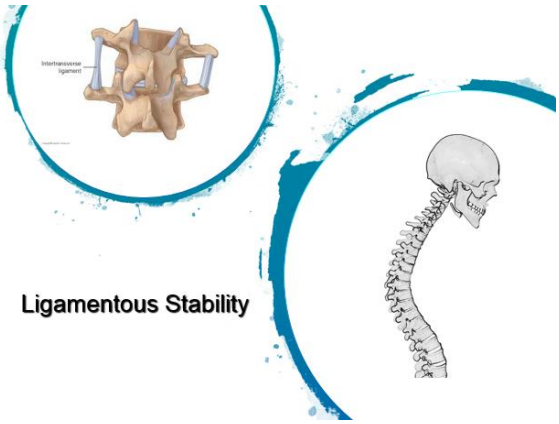
Alignment





Some health care practitioners have the philosophy that the structure and alignment of our bones dictates our posture, alignment, and some believe our overall health. Posture and alignment are extremely important for optimal function, but it is the muscle system that is responsible for maintaining our posture and alignment. If you were to attempt to reconstruct the human skeleton by stacking the bones from the feet to the head without the support of the ligaments, and fascia, you would fail. If you added the ligaments and fascia the spine would still fall over.

It is the active control of the muscle system that supports the spine both statically and dynamically. Since the muscles become imbalanced and restricted based on common postures and movements leading to a re setting of the intramuscular mechanoreceptors, our posture and dynamic movements become dysfunctional. Therefore, normalizing and restructuring the active segmental motor control of the spinal muscles is essential and will lead to improved posture, improved biomechanics and ultimately a decrease in pain and dysfunction.

For long term spinal health our spines demand proper segmental motor control. The *Total Spinal Fitness Muscle Pattern Re-Organization Technique* provides the only system that sequentially activates the core muscles of the lumbar spine with emphasis on proprioceptive specificity to restore optimal segmental lumbo-sacral motor control first.

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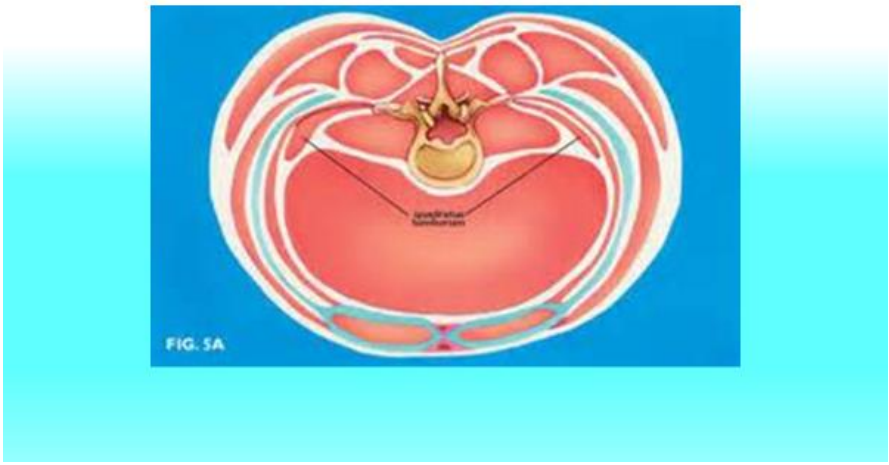
What is Our True Core?



What is our true core? You will find many different opinions in the literature. Some feel the pelvic floor and the Diaphragm are important core muscles. Others insist the Transverse Abdominus is the most important core muscle. The reality is all our trunk muscles are important and work in a coordinated synergy to provide optimal movement and stability of the trunk.

A trip to the gym or a session with a personal trainer now routinely consists of more aggressive core exercises, including swinging heavy kettle bells, swinging heavy ropes, pushing heavy weighted sleds, and performing planks and burpees. These are great exercises for strengthening the larger outer trunk muscles, but in some cases can also load the spinal discs. Are these exercises really strengthening our true spinal core muscles?

Many of the important core muscles are hidden beneath the exterior musculature people typically train.

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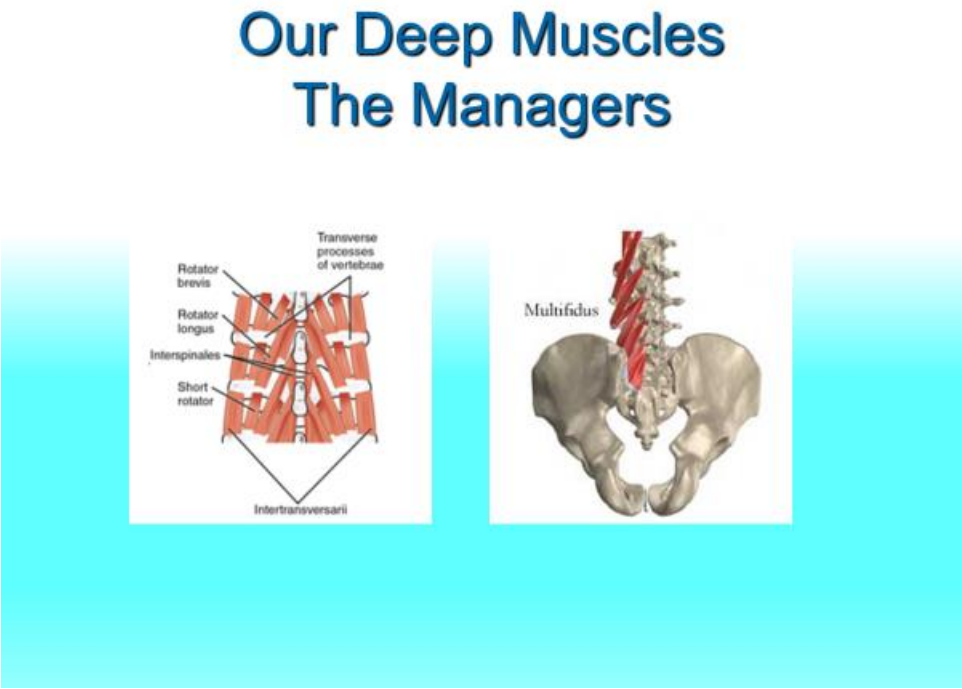
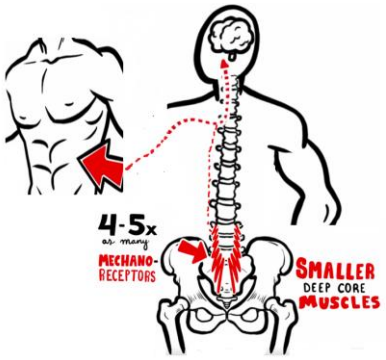
The Muscle Pattern Re-Organization Technique Breaks Down the Core Muscles of the Spine into Three Functional Levels.

1. The Deep Core



The definition of core is **"**the most central or most important part of something**".** At the true deep core of our spine, we have small spinal muscles called the Intertransversarii Medialis and Lateralis, Interspinalis, and Multifidus. These are the most central and are especially important core muscles, yet there is little focus on facilitating these muscles in most spinal rehab and core fitness protocols.

Yes, the larger outer muscles are important and provide the power to move the spine, but the density of mechanoreceptors in the smaller intersegmental muscles is much greater than their larger counterparts. In fact, there are 4-5 times as many mechanoreceptors in these deeper muscles than in the larger outer muscles, and this effectively demonstrates their importance. If we have segmental immobility, then the proprioception from these small muscles is stifled. One of the simplest ways to restore coordinated muscle activity in the spine is to ensure that we have proper segmental mobility allowing the intersegmental muscles to fully contribute their proprioceptive feedback. This will help to provide and facilitate proper motor control of the spine.



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Multifidus Lumborum

The Literature provides many studies demonstrating the significance of the Multifidus Lumborum Muscle as a prime lumbar stabilizer.

The multifidus muscles lie deep to the semispinalis muscles, where they fill the groove between the transverse and spinous processes of the vertebrae. This group consists of multiple muscular and tendinous fasciculi that arise from the dorsal aspect of the sacrum and posterior superior iliac spine, mamillary processes of the lumbar vertebrae, transverse processes of the thoracic vertebrae, and articular processes of the lower four cervical vertebrae. These fasciculi ascend two to four (or sometimes five) vertebral segments before ending on a spinous process. Multifidi muscles insert onto all the vertebrae except the atlas. The multifidus muscles produce extension of the vertebral column. They also generate some rotation of the vertebral bodies away from the side of contraction, and they are also active in lateral flexion of the spine.

This muscle group has been found to contract during axial rotation of the trunk in either direction (Oliver & Middleditch, 1991). When the oblique abdominal muscles contract to produce trunk rotation, some flexion of the trunk is produced as well (see Anterolateral Abdominal Muscles). The multifidus muscles oppose this flexion component and maintain a pure axial rotation, thereby acting as stabilizers during trunk rotation. The multifidus muscles are innervated segmentally by the medial branches of the posterior primary divisions of the spinal nerves.

In the lumbar spine, where the multifidus group is best developed, this muscle mass is arranged into five bands, each attaching superiorly to one lumbar spinous process (Macintosh et al., 1986). In each band the deepest fascicles run from the mamillary process below to the lamina of the vertebra two segments above. The more superficial fascicles are longer and run from mamillary processes to spinous processes three to five segments above. In the lower lumbar spine, the inferior attachments of the fascicles include the posterior aspect of the sacrum lying adjacent to the spinous tubercles, posterior sacroiliac ligaments, posterosuperior iliac spine, and deep surface of the erector spinae aponeurosis.

Each band of the multifidus lumborum muscle mass is a myotome arranged such that the fibers that move a particular lumbar vertebra (e.g., those that attach superiorly to a single spinous process) are innervated by the medial branch of the dorsal ramus of that segment's spinal nerve. For example, the multifidus band inserting onto the spinous process of L2 is innervated by the medial branch of the dorsal ramus (posterior primary division) of L2. Specifically, in the lumbar region, the multifidus muscle mass produces primarily extension (Macintosh & Bogduk, 1986). Rotation of the lumbar spine is seen only secondarily, in conjunction with extension.

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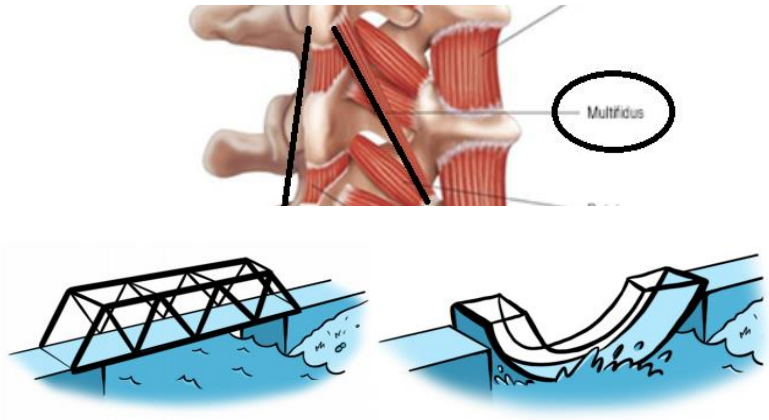
Change is dependent on input from higher centers of the CNS.

The reported changes in activity of multifidus are consistent with changes in its morphology and fatigability, which in turn could be explained by altered use of the muscle. For example, studies report changes in muscle fiber composition and increased fatigability, and reduced cross-sectional area of multifidus has been identified as little as 24 hours after the onset of acute, unilateral LBP.

There has also been found to be an alteration in control of the deep intrinsic spinal muscles that consistently manifests as hypoactivity. Causing LBP is sustained activity of the erector spinae muscles at the end of range of spinal flexion, a point at which the erector spinae muscles are normally inactive (the so-called flexion–relaxation response).

Structural stability is based on cross struts.

The deeper core muscles stabilize the segments of the spine in a crossing pattern. Imagine a steel constructed bridge. Without the added strength of the cross struts, it would collapse even if not placed under significant load. This is where our true core stability comes from.



The Total Spinal Fitness Muscle Pattern Re-Organization Technique is the **only** system that isolates the primary movements of the Multifidus Muscle in the safe unloaded position.

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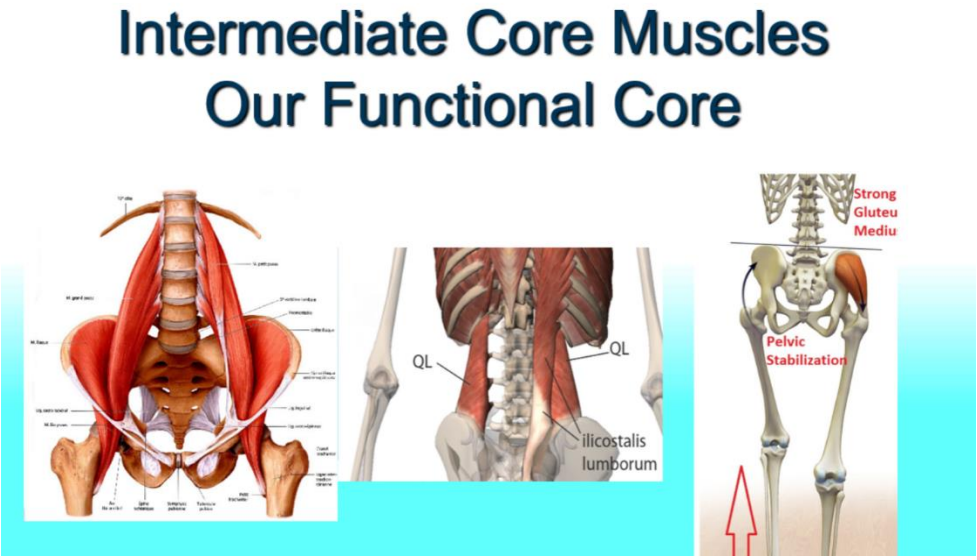
2. The Intermediate Muscles



We have three muscles in this layer. The Quadratus Lumborum, Psoas, and Gluteus Medius. These three muscles play a particularly important role in functional spinal stabilization during single leg support. These muscles work together to maintain the functional stability of the spine while walking. The Psoas Muscle is sometimes made out to be an evil muscle that we must stretch but avoid strengthening. Yet we frequently strengthen the Quadratus Lumborum (QL) along with the other larger spinal muscles. While walking, our most frequent functional movement, we need the Psoas to be in balance with the Quadratus Lumborum and Gluteus Medius to maintain spinal stability. Total Spinal Fitness provides exercises to facilitate this synergy between the Psoas, Quadratus Lumborum, and Gluteus Medius.

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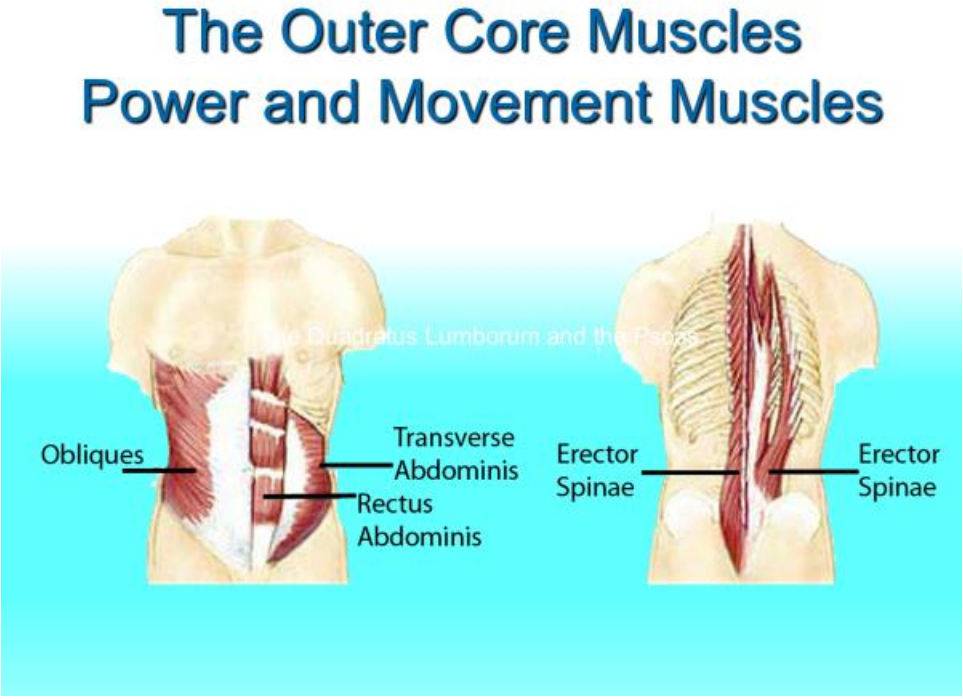
3. The Outer Core



The larger outer core muscles (including the Gluteal Muscles) are our powerful movement muscles. They are involved in lifting, bending, trunk rotation, sit to stand movements, supine to seated movement, as well as strong trunk stabilizers during heavy pushing and pulling movements.

Most spinal rehab protocols tend to focus their efforts on strengthening these outer movements muscles. These large outer movement muscles are important but are not necessarily our true spinal core muscles. We also use techniques that involve co-contracting the paraspinals and abdominals at the same time with abdominal bracing techniques. This is a natural contraction pattern during a few forceful activities that involve stabilizing the trunk during specific movements that demand trunk stability, but not necessarily a natural contraction pattern during many functional trunk movements. Consciously overriding our natural contraction sequence by co-contracting the abdominals during functional trunk bending and leaning can increase inter discal pressure and can limit segmental movement thus limiting the proprioceptive feedback from the intersegmental muscles. Total Spinal Fitness focuses the strengthening exercises that facilitate natural sequential muscle activity.

Using proprioceptive specific techniques to engage the deeper core muscles with the greatest number of mechanoreceptors first is a key principle of Muscle Pattern Re-Organization. Think of these muscles as the rotator cuff of the back. Having strong deltoids (the larger outer movement muscles of the shoulder) without control of the smaller deeper rotator cuff muscles will lead to a dysfunctional shoulder. Focusing our strengthening program on the larger outer movement muscles of the spine is like strengthening the strong deltoid muscles with a weak rotator cuff underneath.

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Restoring Functional Lumbo-Pelvic Rotation

Total Spinal Fitness System is centered around restoring optimal spinal biomechanics.

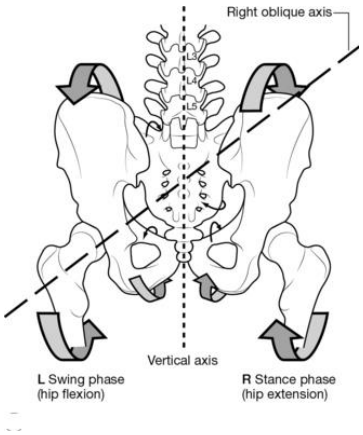
We used our most natural and functional motion of gait as our guide. As the left limb swings forward, the left side of the pelvis also moves posteriorly so that the pelvis rotates to the right. During stance for the right limb, the pelvis then rotates anteriorly. This causes the pelvis to rotate to the right along the right oblique axis. During this functional gait motion the spine also slightly rotates and side bends segmentally.

Studies suggest that a rhythm with high pelvic rotation and poor segmental lumbar movements involves more global muscles and increases the role of the disc in resisting spinal loads, while its counterpart, with low pelvic rotation, recruits more local muscles and engages the ligaments to lower the disc loads. On the other hand, a normal rhythm that has balanced pelvic and lumbar rotations yields almost equal disc and ligament load-sharing and results in more balanced synergy between global and local muscles. Restoring this normal lumbopelvic rhythm is essential for not only proper motor control but will decrease the loads on the lumbar discs.

When patients are told that walking is greatly beneficial for the back this can be a double edge sword. Walking with faulty lumbopelvic biomechanics will lead to continued dysfunction and facilitate improper muscle activity and poor motor control. If we can restore the proper lumbopelvic biomechanics of gait, then walking now becomes a functional exercise to restore and maintain lumbar function.

It has also been reported that transitional movements such as pelvic rotation/de-rotation and lumbar extension at the start of “Up lift” is primarily initiated by pelvic motion.

The Total Spinal Fitness Functional Muscle Therapy System is the only system using proprio pads at the oblique axis on the sacrum while performing our specialized proprioceptive exercises. With the addition of our resistance bands this exercise will help to restore the natural biomechanics and timing of lumbopelvic motion.



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Chapter 3

Regional Interdependence

Pivotal Upper Extremity Subsets
Pivotal Lower Extremity Subsets
Biopsychosocial Regional Interdependence Subset
Regional Interdependence and Patient Education
Myofascial Adaptations

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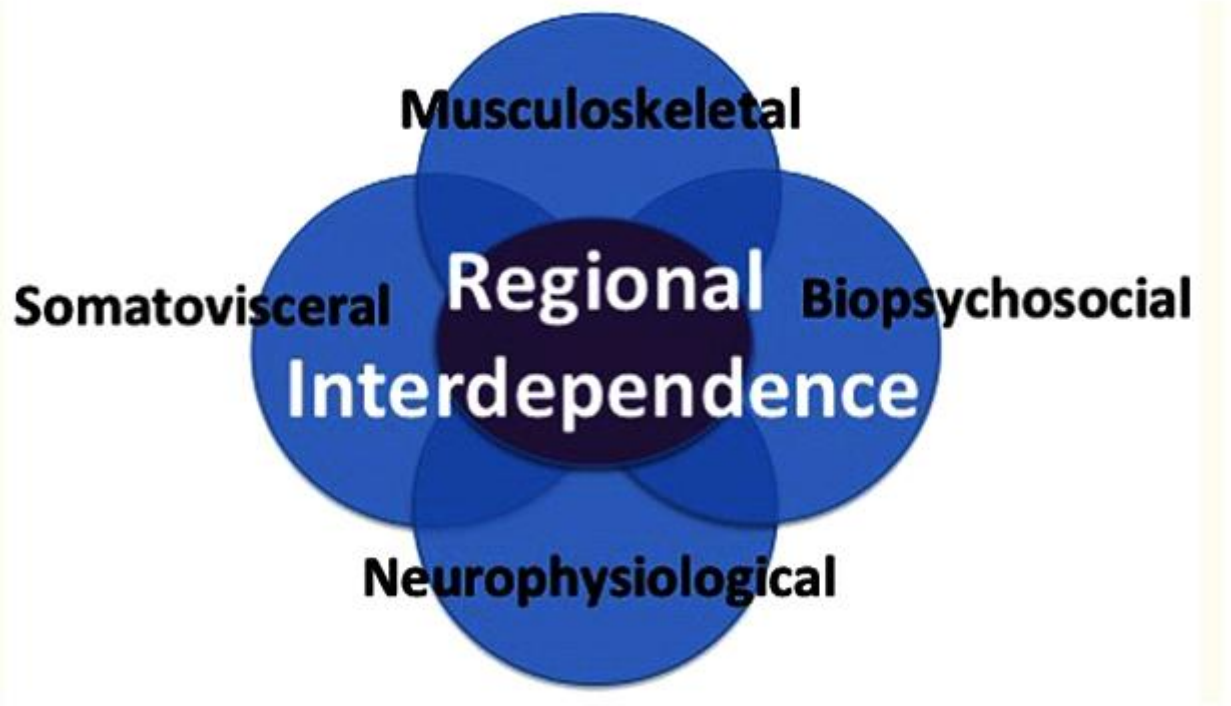
Regional Interdependence



Regional interdependence is the term that has been utilized to describe the clinical observations related to the relationship that exists between regions and systems of the body, specifically with respect to the management of musculoskeletal disorders.[1]
Since Muscle Pattern Re-Organization is a proprioceptive specific treatment approach, based on the principle of regional interdependence we have identified other common factors or regions that may contribute to the patient's spinal dysfunction based on proprioceptive input.

Regarding the relevance of the RI model in physical therapy research and practice, the literature concludes RI warrants further examination and scientific scrutiny. If you ask me RI is basic common sense. When it comes to how the position or movements of one region of the body can affect another region or the site of pain, it seems obvious to me that the most musculoskeletal regions of the body are interdependent upon one another. The example earlier in this book of the ipsilateral HS firing a split second before lifting the arm is a perfect example of this.

Although we often have and like to see post session improvement, the problem with the in session "test-treat-retest" approach is that if we are re setting the proprioceptors it may take many days for the movements to normalize. This is because now that the threshold positions of the mechanoreceptors are re set and proper signals are now being sent to the CNS regarding positional sense the many regions of the body and as the more these regions continue to move the more the body will continue to correct. I often have patients state that it was several days following the sessions that they really noticed a significant improvement.

The regional interdependence model as defined represents the musculoskeletal manifestation of a larger interdependent process by which other systems may be involved in eliciting these musculoskeletal changes.

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Regional Interdependence is a treatment model that accounts for how the body performs as a functional unit or how one region can influence another. In other words, it is the concept to explain how a patient's low back dysfunction can be triggered by postural and movement dysfunctions in other regions of the body. Performing our proprioceptive specific techniques without eliminating the major triggers for the muscular dysfunction we are treating would be a great disservice to our patients.

The focus of this course is proprioceptive specific techniques to optimize spinal biomechanics and we will not be going into detailed treatment approaches for many of the other regional dysfunctions that contribute to spinal dysfunctions. We will be going over simple techniques to address the scapula, hips, and feet as these contribute significantly to spinal muscular dysfunctions. This section will outline several of the most common regional dysfunctions that contribute to spinal dysfunction and can be used as guide for you to formulate your comprehensive treatment approach.

This is a large subject, but we will focus on a few of these interdependent relationships that will affect the mechanics of the lumbar spine. When it comes right down to it the lumbar spine is in the middle of the body. Therefore, it seems logical that posture or movements above as well as posture and movement below the will be compensated at the lumbar spine region, and as therapists we see this and treat this every day.

The thoracic spine and cervical spine are obviously attached to the lumbar spine and will affect the movements and position of the lumbar region. The position of the hips also directly affects the position and biomechanics of the lumbar spine. When it comes to reestablishing optimal muscle sequencing and optimal movement of the lumbar spine addressing the regions above and below is essential. Let's look back at the study of Lacquaniti, Ivanenki, and Zago, on Patterned control of human locomotion.

Movements are controlled using a small set of basic activation patterns and are shared by several different muscles and reflect global kinematic and kinetic changes.

Not only does this describe regional interdependence it tells us that if we focus on the pivotal small subset of basic activation patterns, we can also have a global effects *with minimal effort.*

Muscle Pattern Re-organization has taken the pivotal small subset of activation patterns in the upper extremity and lower extremity that we feel will have the greatest impact on normalizing the movements of the spine.

Our goal was to choose the pivotal small subsets of movements in the UE's and LE's that will have the greatest impact with the fewest movements. The following examples and interventions to promote improved spinal posture are based on the most common simply correcting the most common postural dysfunctions.

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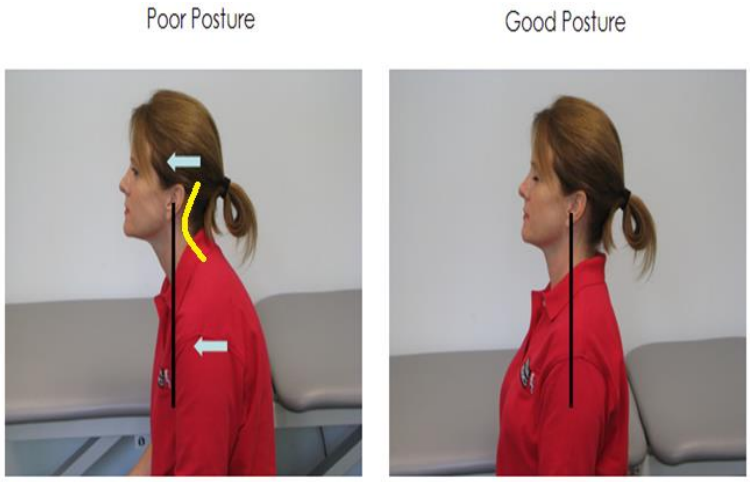
Pivotal Upper Extremity Musculoskeletal Regional Interdependency Subsets

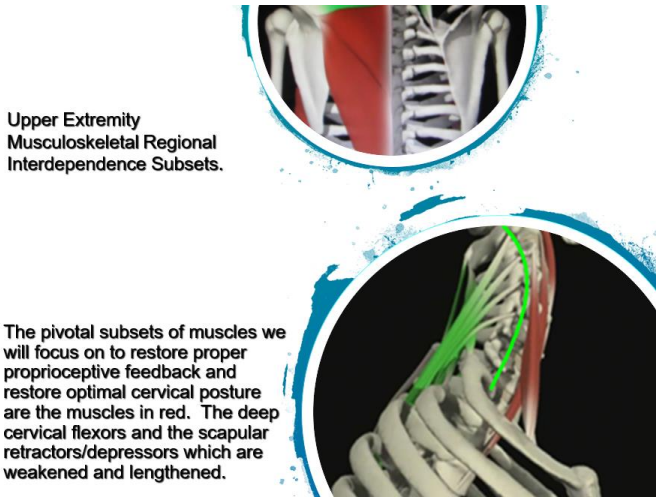
The most common postural dysfunction is forward head posture associated with forward shoulder posture. This causes the cervical spine to increase the natural curve and can place increased stress on the joints of the neck. This posture can also increase the tone of the sub-occipital musculature at the base of the skull and may cause headaches.

When the shoulders and head move forward muscles can become unbalanced and stressed, joints can be placed in compressed positions, and myofascial bands can shorten and tighten. Good neck posture is illustrated by the picture on the right.



Neck pain is a common complaint among employees who use a computer workstation, but this is the same postural fault commonly seen when driving, watching TV, texting on smart phones, and playing video games. The long-term problems associated with this posture are due to the joints of the neck, which are lined with articular cartilage. When the neck is in extension these joints are compressed damaging the cartilage. This damage can be more serious because cartilage does not repair and heal as well as muscle and this damage can cause chronic neck pain.

The picture to the right demonstrates the effects forward shoulder posture can have on the muscle balance of the neck. When sitting slouched the shoulder blades move forward. This causes increased tone in the pectoralis minor muscle. When the pectoralis musculature is tight or tense the lower trapezius, middle trapezius and rhomboid muscles are weakened and stretched (seen in red in the upper picture) This causes an increase in tone of the upper trapezius and scalene muscles. This imbalance is further exacerbated by the tensioned (weakened and stretched) deep neck flexors (seen in red in bottom picture). Effecting these two subsets of muscles will have the greatest impact on restoring proper neck and upper back posture.



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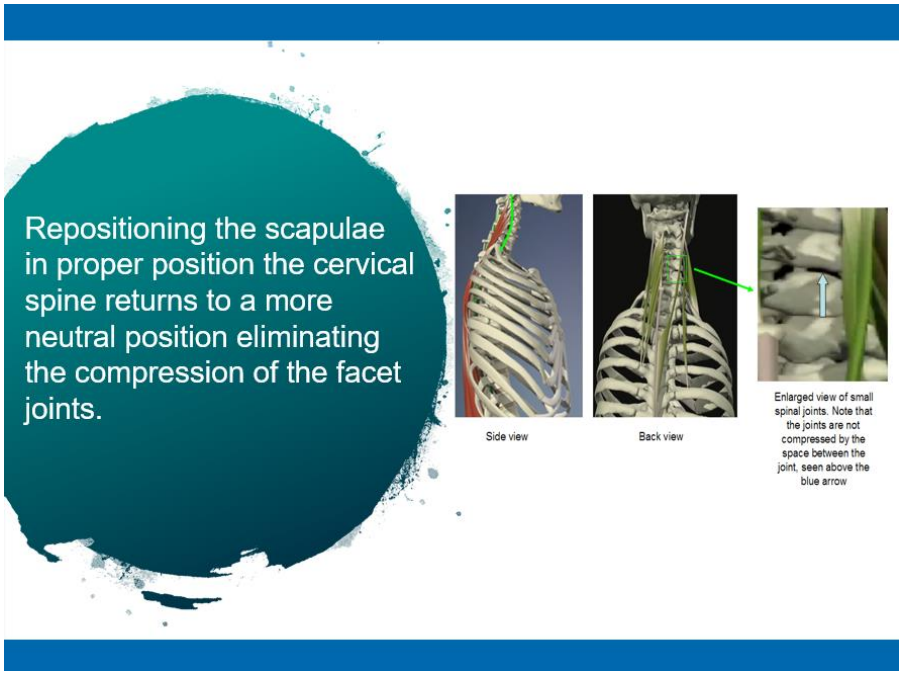
The illustrations to the right demonstrate how this regional dysfunction cause damage to the joints of the cervical spine.

This can lead to degeneration and inflammation of the spinal joints.



Repositioning the scapulae has a direct and significant effect on the cervical spine balancing cervical posture and taking the compression forces off the facet joints.

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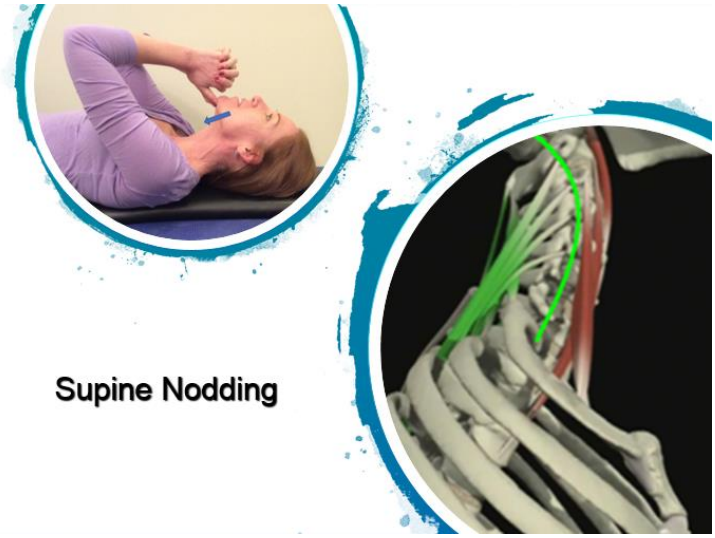
The pivotal small subset of movements (activation patterns) we will use to create a global change in upper back posture and neck posture are simple proprioceptive specific techniques addressing the two major players which must be re-patterned. The deep cervical flexors and the scapular retractors.



Supine Nodding

First the deep cervical flexors:

Supine Nodding is the first simple exercise. Have your patient lay prone and gently resist neck flexion. Start with the neck in slight extension and resist into slight flexion. It is especially important to perform this exercise prone with the head supported in order to avoid patterning the tonic SCM muscles.

Second the Scapular Retraction/Depression exercise.
This exercise is simply extending the elbows, wrists, and fingers while retracting and depressing the scapulae. It is important to keep the neck relaxed while performing this exercise to avoid any tonic muscular patterning. This is a repatterning movement and should be encouraged to be perform frequently. We had great results incorporating this exercise into our injury prevention program while working with the Intel Corporation. This exercise re-patterns the phasic muscles that oppose the muscle groups associated with sitting and working on a computer.

Scapular Retraction/Depression

These two quite simple exercises will have a global affect on improving the postural control of the neck and mid back.

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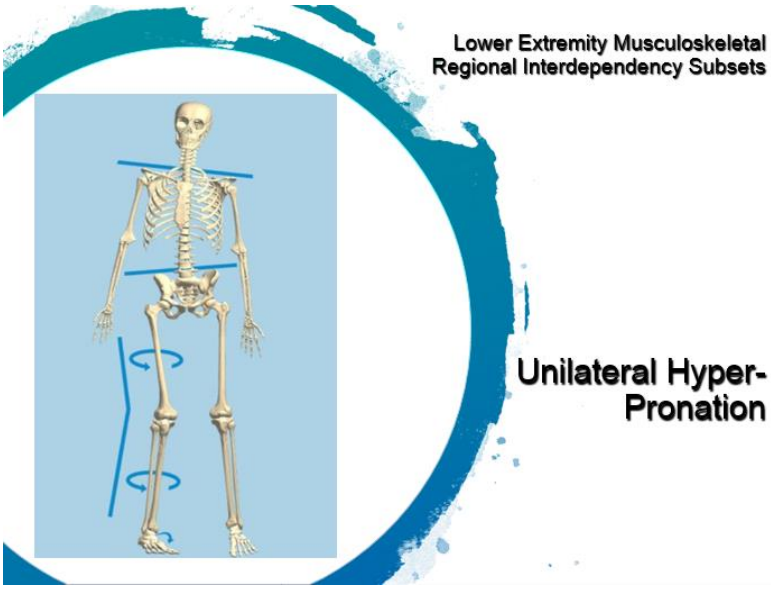
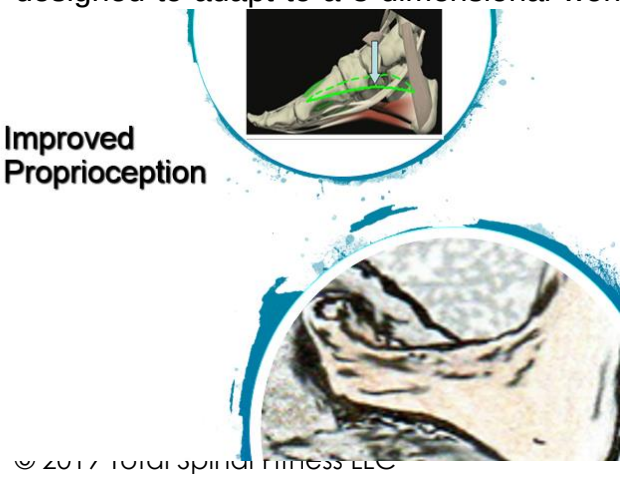
Pivotal Lower Extremity Musculoskeletal Regional Interdependency Subsets



In the lower extremity one of the major and pivotal regional subset of movements that creates the greatest impact on altering proper spinal posture is unilateral hyper-pronation. When you start looking for this dysfunction you will find it more prevalent that you would have thought. Unilateral hyper-pronation causes internal rotation of the lower leg which then causes a cascade of muscular and structural dysfunctions all the way up to the neck.

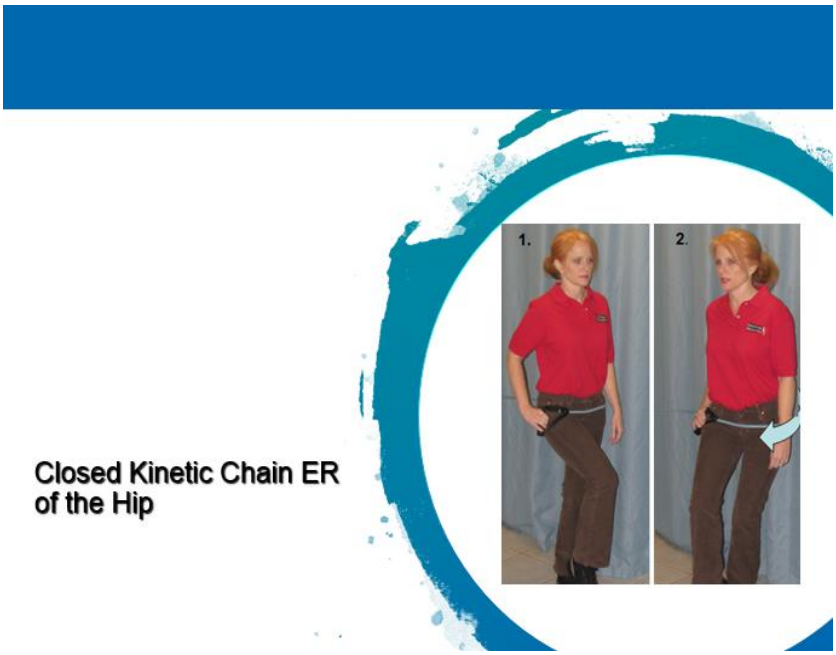
This pivotal subset of activation patterns to be addressed with hyper-pronation is simply restoring the mass position of the hyper-pronated ankle which will eliminate the internal rotation of the lower leg. Proper orthotic fabrication will control the foot and ankle and prevent this internal rotation.

Our program is based on proprioceptive specificity in all treatments. Another aspect of orthotic therapy is improved proprioception. Our feet were designed to adapt to a 3-dimensional world which would force the foot to adapt to the contours of the ground demanding much greater kinesthetic proprioceptive input from the ankle and intrinsic foot muscles. A good orthotic will not only decrease hyper-pronation it will provide increased proprioceptive input as a much greater portion of the foot will be touching the orthotic throughout the gait cycle simulating the contours of the real world.



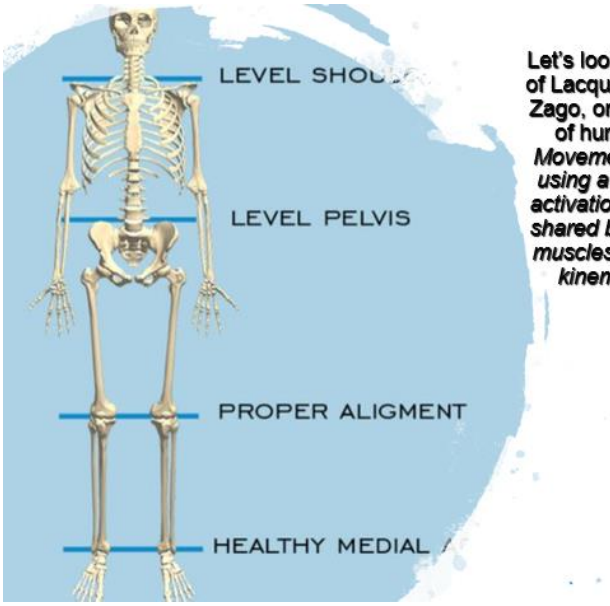
Closed Kinetic Chain External Rotation of the Hip

We have also developed an advanced exercise to address this lower extremity subset of movements. This exercise strengthens the external rotators of the hip in the functional closed kinetic chain position.



By simply wrapping a strong resistance band around the waist, standing on single limb support and moving from a position of internal rotation to neutral the hip external rotators in conjunction with the functional core (Psoas, Quadratus Lumborum, and Gluteus Medius) will help re-establish proper muscle patterning to help resolve this regional subset of movements.

Re-establishing these simple movement patterns in these pivotal upper extremity subsets and lower extremity subsets will make significant global changes to the position of the spine and to the biomechanics of the spine.



Let's look back at the study of Lacquaniti, Ivanenki, and Zago, on Patterned control of human locomotion. *Movements are controlled using a small set of basic activation patterns and are shared by several different muscles and reflect global kinematic and kinetic changes.*

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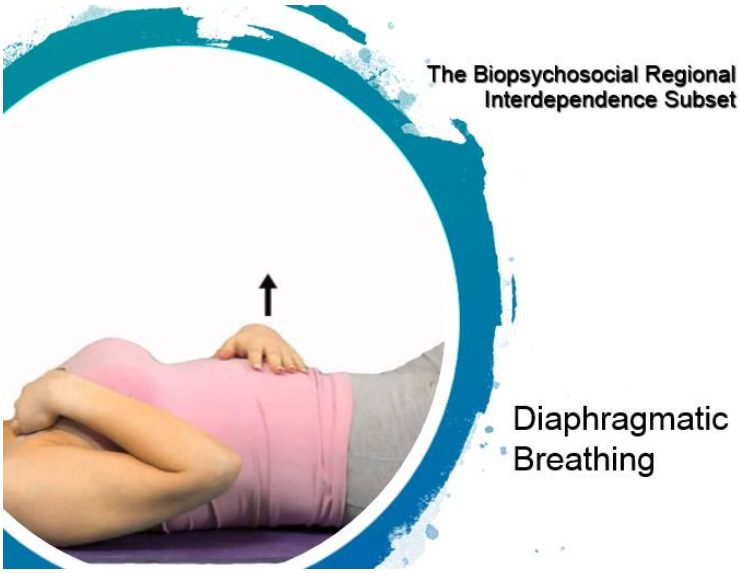
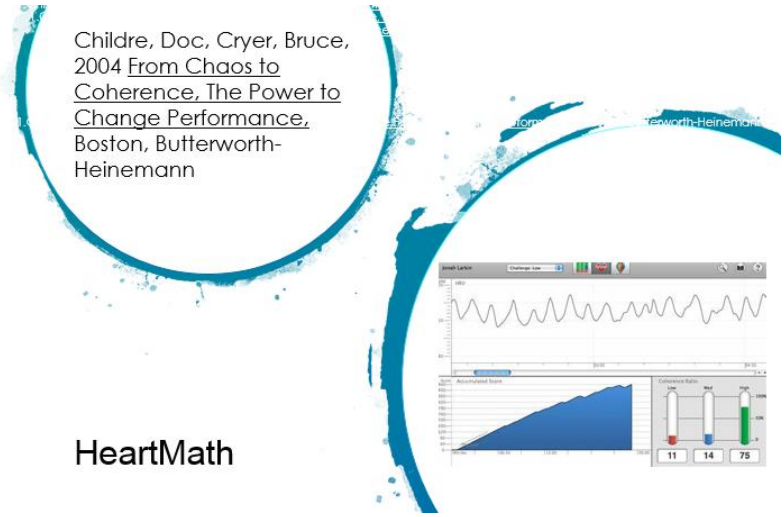
The Biopsychosocial Regional Interdependence Subset



This regional subset is based on the eliminating he upregulated Autonomic Nervous System. As discussed earlier in this manual the ANS can override the CNS during times of stress. Although it is not in our scope of practice to address biopsychosocial issues, we can address the movement of the diaphragm as this muscle plays in integral role in regulating the ANS.

Addressing the diaphragm and teaching our patients diaphragmatic breathing can deregulate the ANS decreasing the tonic muscular protective patterns which may be exacerbating their muscle dysfunction.



HeartMath is a company that studies heart rate variability. Heart rate variability has been determined to be an objective measurement of the state of our ANS. Their studies have demonstrated objective empirical evidence that restoring proper diaphragmatic breathing will balance the ANS moving us our or sympathetic mode toward parasympathetic mode. Thus, decreasing the sympathetic activity that can lead to muscle tension of the tonic muscles.

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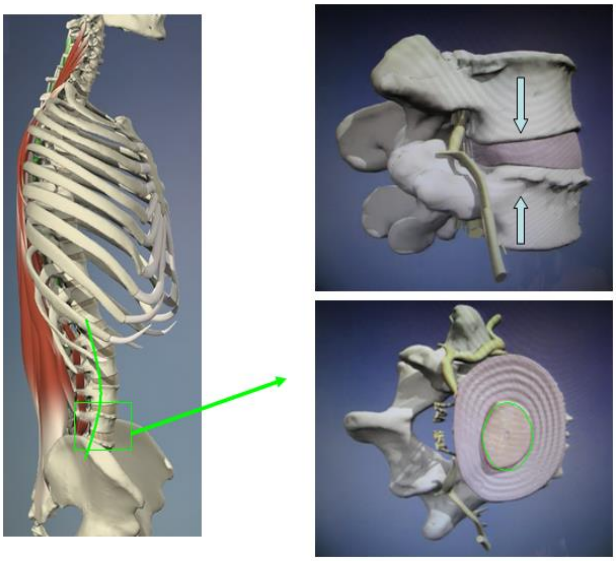
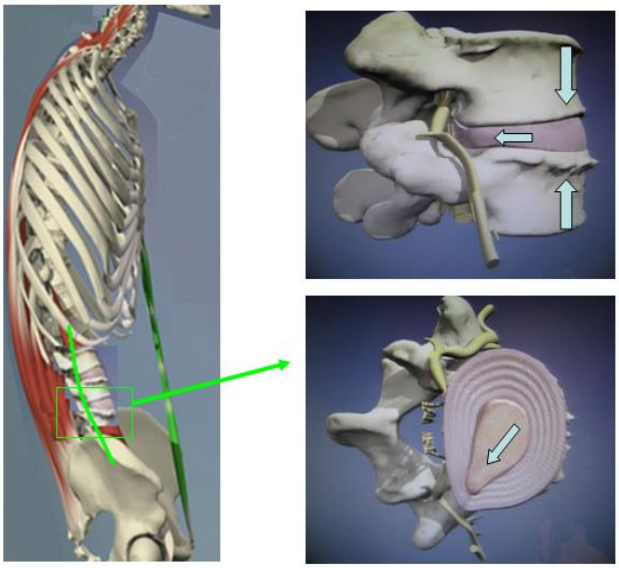
Regional Interdependence and Patient Education

Treating the spine or any other region of the body without teaching our patients proper postures and proper body mechanics to avoid continual tissue damage and muscle imbalances is essential. If our patients leave our office and perform the same faulty postures and body mechanics which probably led to their dysfunction in the first place, we are wasting our time and theirs. It is common knowledge that bending at the waist and sitting slouched is bad for the back and can strain the muscles and ligaments of the low back. More importantly one must understand the impact this posture has on the lumbar discs. Muscles and ligaments can heal, but the spinal discs, once damaged rarely heal.



The animation to the left illustrates proper lumbar posture. This posture is typical of our normal standing posture. Make sure, when sitting, that you attempt to maintain this posture. Your weight will be on the bones under your glut muscles. I call these the sit bones, and if you are wearing pants these bones are roughly at the bottom of the back pockets. Note that with proper lumbar posture there is even pressure on the discs of the spine. Maintaining this posture will help to keep the discs healthy.

The animation to the right illustrates how poor posture can increase the stress on the lumbar discs. When sitting back on your tail bone your spine reverses the normal inward curve. These places increased stress on the front of the spinal discs. Since the spinal discs have a jelly like center, this posture pushes the jelly backwards (seen in bottom right picture). If this posture is maintained the disc can bulge all the way out and press against the nerve. Sitting in this position can cause the same damage to the discs as bending and lifting movements.



You will receive our custom produced computer-generated disc animation to help to educate your patients on the importance of maintaining proper posture and body mechanics to maintain healthy spinal discs.

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Myofascial Adaptations

This course will not provide myofascial treatment approaches, but I will address these restrictions as they are part of the regional interdependence subsets that can have a large impact on spinal mobility.

Fascia is strong, mostly inelastic tissue that holds us together. Fascia is the connective tissue that is present everywhere in the body; it surrounds each muscle cell, each muscle, and each group of muscles, each organ, and the entire body. Its function is to organize, support, and *lubricate* every organ, muscle, and structure in the body. Although mostly inelastic, it can produce a vast array of materials which will rearrange themselves in response to individual activity and injury. Stress going through the fascia stretches the bonds between the molecules creating a slight electric flow known as a piezo-(pressure) electric charge. This charge is read by nearby cells which respond by augmenting, reducing, or changing the intercellular elements in the area to best accommodate the stress. In healthy fascia the smooth coating permits neighboring structures to slide over one another. However, following inflammatory illnesses, traumatic injury, or continued strain due to the static postures and movements associated with our modern environment, layers can adhere to one another in glue-like fashion. They no longer slide but instead cause adjacent structures to tug on one another. At the same time the underlying muscle becomes shortened and undernourished, and their function reduced as nutrients and chemical messengers struggle to make it to their intended cells. Remember, no muscle acts alone. Muscles are always communicating with each other, and the shortened and tight underlying muscle (muscle tension), which was disrupted by a tight fascial band, will tell its opposing muscle to relax (reciprocal inhibition), this becomes the tensioned muscle. This leads to dysfunction and muscular imbalance as well as fascial immobility and tightness. The fascia follows the paths of muscle so if a muscle has increased tone (muscle tension), then the fascia which follows it may become restricted a viscous cycle.

The picture to the right is of the sternum and the superficial fascia which crosses the chest. Note the white fascial band crossing from the top left to the lower right. This is an example of the increased fascial development in someone who is right hand dominant and demonstrates how our postures and movements can influence the development of fascial bands.

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A more simplistic approach to understanding how fascial restrictions and tightness can affect the musculoskeletal system can be seen in the photos and diagrams below. Figure 1 shows how shortened and restricted deep front fascial bands cause tightness and tension in the muscles and fascial bands of the low back. Although this is caused by restrictions in the front fascial bands the pain is usually felt in the tight structures of the low back. Figure 3 demonstrates the mechanics of tight fascial structures. The black structure in the middle of the green fascial bands illustrates the affect the fascial imbalances have on the skeletal bony structures. Note that the skeletal structure in the middle of the fascial bands will bow away from the shortened restricted side causing reversal of the natural lordotic curve of the low back. Use the diagram in figure 3 to help determine the skeletal imbalances which can be caused by fascial restrictions. Figure 2 and 4 illustrate the skeletal balance when the fascia is healthy and mobile. Functional Muscle Therapy incorporates dynamic fascial mobilizations as part of the exercise interventions. These exercises will help to provide a comprehensive treatment approach.

Figure 1

Figure 2

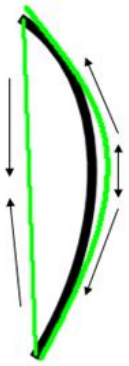
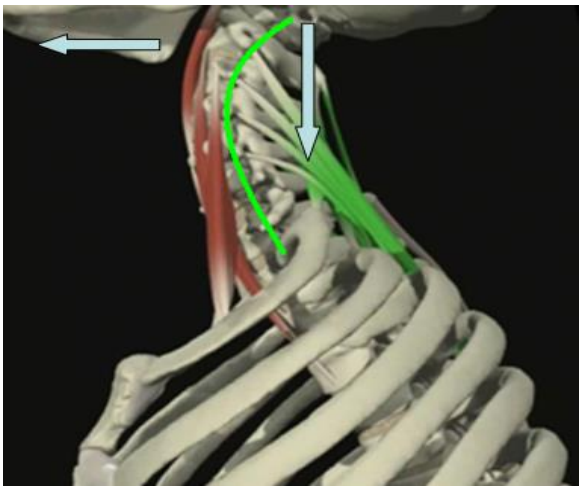


Figure 3

Figure 4

Note: As discussed in the regional interdependence section because the anterior upper front fascial bands attach behind the ears, the head us pulled down causing increased cervical lordosis. So, the neck is the exception to the rule in the diagram in figure 3 and this is the reason we facilitate the tonic deep neck flexors in the pivotal movement subsets for the neck.



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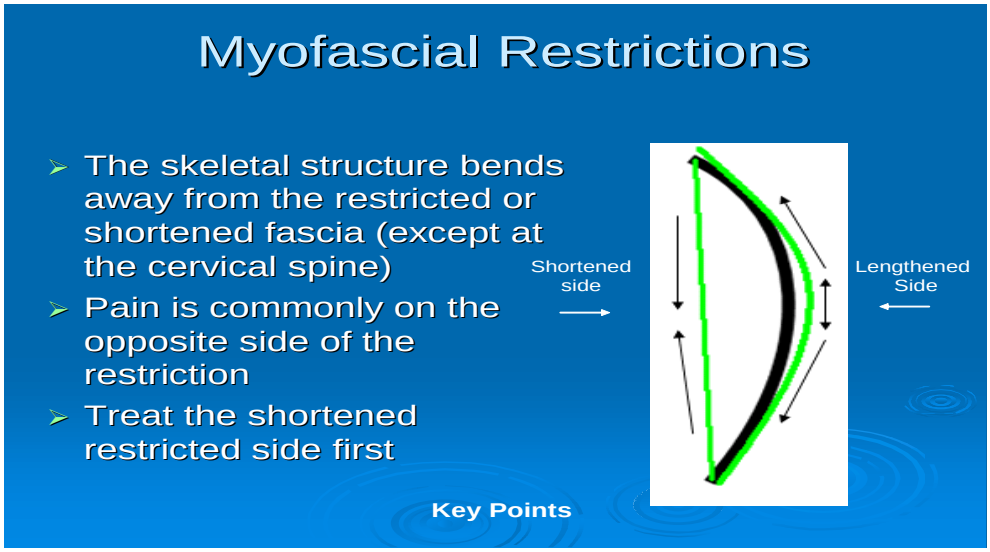
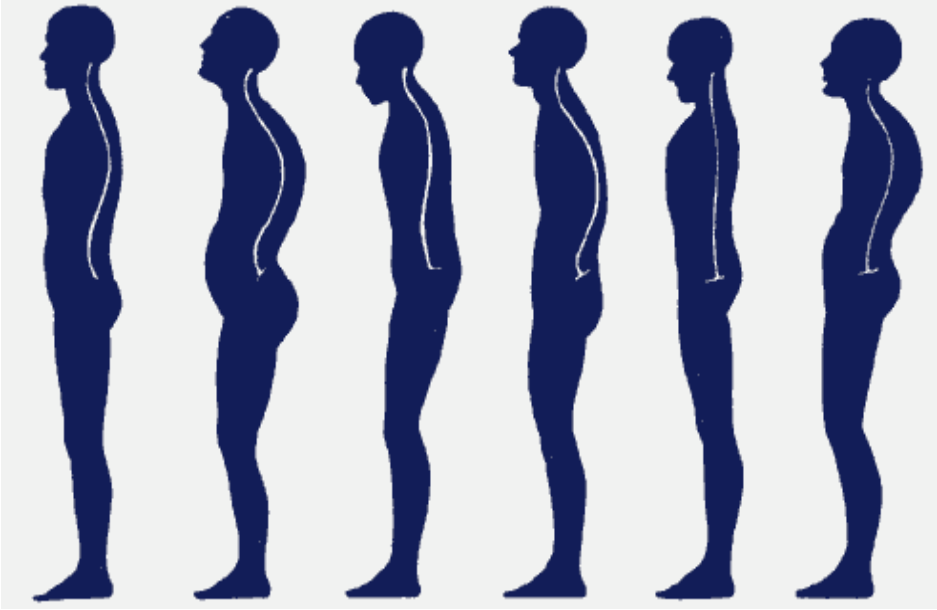


Except for tightness in the anterior fascial bands of the neck you can use the diagram above to easily determine the side of greatest restriction which will help you to quickly develop a treatment intervention. The first posture on the far left is the ideal posture. Which ever direction the spine is bowed away from this ideal posture is the side of tension. Remember, treat the opposite side first. For example, in the posture on the far right there is an increase in thoracic kyphosis (spine bowed backward) and in the lumbar spine there is a reversal of the lordotic curve (spine bowed forward). Therefore, treat the chest restrictions to normalize the thoracic region and treat the low back restriction to normalize the lumbar region.



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Chapter 4

Principles of Muscle Pattern Re-Organization Exercises

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Principles of Muscle Pattern Re-Organization Exercises

1. Repetitive Input of Optimal Muscle Patterns Focusing of the Muscle with the Most Proprioception First (Proprioceptive Specificity).

If a posture or movement is performed repetitively these muscle patterns tend to become more active. This can be further ingrained into our CNS if these patterns are closely related to the tonic protective response ("default setting"). This is where our modern environment filled with seated postures in front of computers, TV's, video games, and in cars, gives repeated input into the CNS to increase the activity of the tonic flexors of the body. The principle of repetitive corrective exercises incorporates repetitive input of new/correct motor patterns. This way not only are we strengthening, but we are also giving specific input to the CNS to facilitate increased tone in muscles which have decreased tone and facilitate decreased tone in their tonic counterparts.

2. Facilitate Phasic Muscle Groups with Regional Interdependence

Our modern environment is filled with seated postures we tend to see increased activity of the tonic flexors of the body. Barring any specific neurological conditions such as Parkinson's or MS it is usually safe to assume an underlying imbalance based of the innate CNS pattern of increased tone in the tonic muscles and decreased tone in their phasic counterparts. This is the most common imbalance and if you base your exercises on this principle you will help to rebalance the muscles and correct the underlying dysfunction. I know it seems like a simplistic approach but if you simply followed the charts given in this manual detailing the tonic and phasic musculature and focused your exercise programs on strengthening the phasic musculature and stretching the tonic musculature you would probably see great results.

3. Unilateral Strength Training

Unilateral strength training should be incorporated to restore muscle function and recalibrate the CNS. The body can easily accommodate for underlying muscular imbalances when performing bilateral strengthening exercises. (Davies G. T., Durall, 2000)

Incorporating unilateral strength training will enhance the effectiveness of your strengthening exercises. As stated in the above study by Davies and Durall it is much easier for the body to accommodate for an underlying muscle dysfunction by using a primary synergist instead of the inhibited primary agonist when performing bilateral strengthening exercises.

The exercises performed with Functional Muscle Therapy incorporate unilateral isolated pelvic and lumbar exercises.

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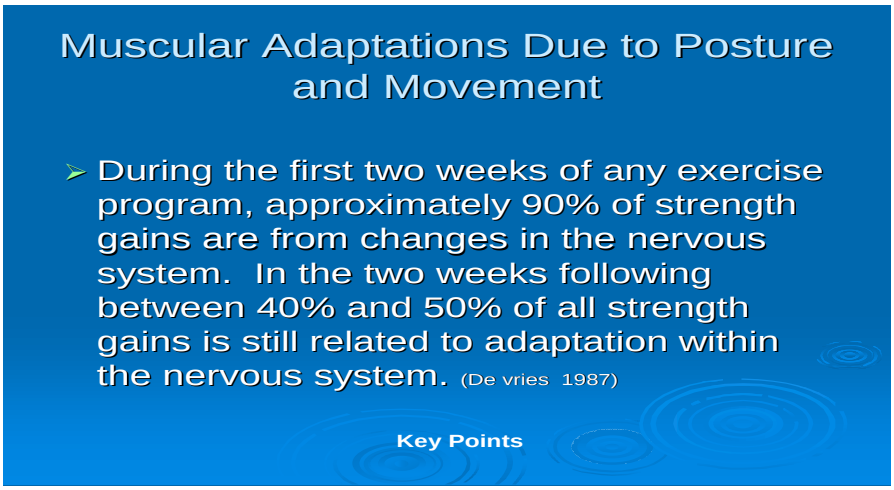
4. Exercise Dosage

The 8-repetition max, the 3-repetition max, and low resistance with high repetitions. These are common exercise dosages and all matched with varying resistance depending on the desired outcome. When performing Functional Muscle Therapy Muscle Pattern Re-Organization these common protocols are simply not specific enough. During the initial phases of Muscle Pattern Re-Organization there is really no need for resistance at all. Remember the study below. Muscle Pattern Re-Organization is based on creating adaptations in the CNS and this is done through repetition. There were no studies that I could find related to specific exercise dosage when the goal is to facilitate muscle pattern re-organization. My protocol begins with instruction to perform the prescribed exercises for several 5- 10 minutes each session and perform 3-4 sessions a day.



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