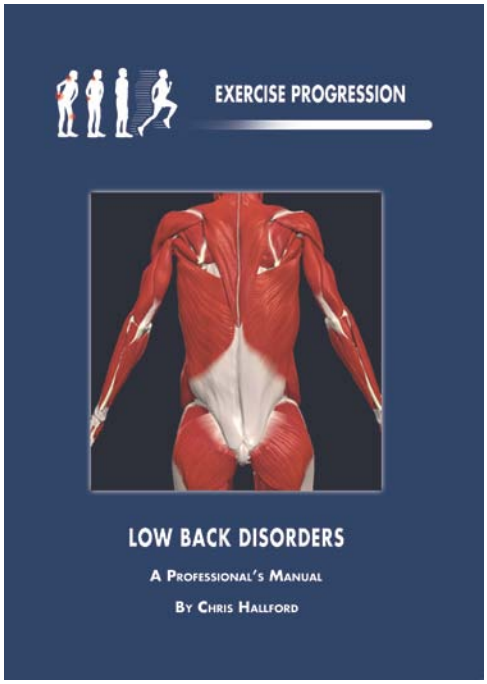
Enjoy a sample chapter from my book**, Exercise Progression: Low Back Disorders -** ***A Professional's Manual***

Contents

This book is used as a tool to teach other allied health professionals how to safely progress exercise programs. You can find it on Amazon here.



"There has always been a large divide between Health Care Professionals and Fitness Professionals. However both of these professions deal with a common client, that is one that has some form of Low Back complaint. What Chris Hallford does throughout this book is cover in detail the topic of Low Back Disorders, and what exercises, slow progressions and assessments can be used when dealing with this population for the Health Care Professional to the Personal Trainer.

Getting all of these professions together with the same understanding, the same terminology and the same approach to helping the client is essential and Chris does this incredibly well. From stretching protocols, the anatomy and physiology, full body assessments to the exercises and movement prescription, every component is covered to allow the professional a full understanding of what causes and what helps alleviate Low Back Pain.

I recommend this book to any professional dealing with clients with any form of mild low back issues, which today is almost everyone at some stage within their life cycle. This is the first brave step to truly integrating the different professionals within the Health and Fitness industry and I applaud Chris for creating such a thorough yet easy to follow guide in this book Exercise Progression, Low Back Disorders. Recommend this to every Health and Fitness Professional you know".
--Richard Boyd, Co Founder, Personal Training on the Net

Chapter 1 Exercise Progression

Corrective Exercising (Go Back to Contents)

The modern day lifestyle in urban areas is becoming more and more sedentary with each new invention that is made for our "convenience." This impairs the normal functioning of almost every system in the body unless corrective actions are taken.

The necessary corrections are those that move the body towards structural alignment and challenge the neuromuscular system (including the heart and cardiovascular system) in a way that promotes health.

This is done with simple movements and exercises based on assessment findings that focus on activating inhibited areas and relaxing overactive muscles. Without this organized system, common strength exercises (if performed on already tight muscles) can increase tightness and reinforce any related antagonistic inhibitions and joint dysfunctions.

Corrective exercise is the foundation of Exercise Progression and is necessary for people who want to function efficiently at any level with less or no aches and pains.

It is possible to go through life without ever exercising and lead a relatively happy life. But, it is also possible for that same person to increase their energy and ease of daily living by performing corrective exercises.

In general, corrective exercising will:

- Decrease daily or activity-related soreness.
- Improve overall energy and functioning by creating a more efficient vehicle.
- Make ordinary and extraordinary tasks easier.
- Decrease the chances of future injuries by improving joint mechanics and muscle coordination.

The hard part to keep in mind is that many people have major imbalances, and yet no pain or discomfort, and seem to live a normal life. This makes it difficult to suggest that all major imbalances are significant, but the following analogy, shared with the author from Tobe Hansen[9], can be used to shed light on why people with similar imbalances can have very different symptoms.

Imagine the body's pain and injury tolerance as an empty cup. Each negative factor that contributes to pain and injury, such as genetics, coping mechanisms, fitness routine, nutrition, daily activities, age, history of injuries, etc., is a drop of water in the cup. Certain instances, such as traumatic events, create larger drops that can fill the cup quickly.

Once the cup overflows, pain and injury occur. But by receiving manual therapy, chiropractic adjustments, or performing corrective exercises, one can remove drops from the cup and thus increase their potential to withstand cumulative trauma.

What causes the last drop is not as important as it being the last drop. Something as simple as bending over to pick up a child or sleeping crooked can be drops added every day that eventually overflow and manifest into symptoms.

Therefore, correcting as many imbalances and habits, starting with the most influential, and scooping out as many drops from the cup as possible is very relevant to preventing and correcting a variety of ailments.

It can be very difficult to convince an asymptomatic person to use corrective exercise in order to improve their lifestyle. It should be impressed upon them, however, that corrective exercise will improve the body's overall function potential and decrease the risk of future injury, aches, and pains by "emptying out their cup."

Corrective exercise is the best first option for non-serious musculoskeletal disorders when combined with the necessary manual therapy, changing of faulty habits, and education. It is a much better option than the others that are utilized, such as medication, non-specific massage and exercise, and rest, which all focus on the symptoms and ignore the cause.

A large part of the success of corrective exercise depends on the exercises being performed often and correctly, which is made easier with handouts and a home exercise program.

Based on the *Law of Facilitation*, once an impulse passes through a given set of neurons to the exclusion of others, it will tend to follow the same course on future occasions, and every time it does, the resistance will be less.

Therefore, in order to initially transform the body, good habits and exercises must outweigh the improper ones. So one hour a day will hardly make an impact on an eight-hour day of sitting. The exercises, D.A.M.'s, and Healthful Hints need to be integrated into daily movements and thoughts so that the body can slowly adapt to a new and healthier lifestyle.

The Kinetic Chain (Go Back to Contents)

The body is physically shaped by how it sits, stands, sleeps, eats, plays, and what it plays. Imbalances accumulate very quietly through bad habits and repetitive stress, announcing themselves only when "the cup overflows" or the tissues can no longer tolerate the strains placed upon them; i.e., not enough rest, too much or too little activity, repetitive stress, poor nutrition, etc.

Posture is the manifestation of myofascial, neurological, and articular functioning and interaction. These three components make up the *kinetic chain*.[14,41,101,102]

Box 1-1 ***Components of the Kinetic Chain***

Myofascial	Articular	Neural
• Fascia • Muscles • Connective tissue	• Bones • Joints	• Nerves • Proprioception • Neuromuscular function

Dysfunction in one component will induce compensations in the other components and lead to decreased neuromuscular efficiency and performance along with increased chance of injury. There is no such thing as an isolated dysfunction. Once a muscle is lengthened or shortened beyond its optimum length, it will be limited in the amount of tension it can produce[14,41,61,67,101,102] and therefore force other areas to compensate.

There are predictable patterns of dysfunction created by misalignments in posture[4,11,41], some of which are upper and lower crossed syndrome and are described in more detail in chapters 12 and 13.

These dysfunctions are in response to the abnormal stresses placed on the structures and tissues throughout the kinetic chain by poor posture, repetitive stress, and unhealthy habits.

For example, when the head and shoulders are slouching forward, the lower trapezius and posterior neck muscles and ligaments have to strain to keep the head up against the increased gravitational pull on the head, not to mention all of the shortened anterior muscles and altered joint mechanics. This can lead to tension headaches, shoulder problems, low back pain, and numerous other dysfunctions.

Dysfunctional patterns are created from *five main types of neuromuscular compensation: 1) reciprocal inhibition, 2) reciprocal facilitation, 3) synergistic dominance, 4) arthrokinetic inhibition, 5) mental influences.*

Reciprocal Inhibition

There are two types of reciprocal inhibition, the first being the normal functioning of reflexes, such as when a muscle contracts, it forces its antagonist to relax.[19] The second deals with a dysfunctional pattern that occurs when a tight or dominant muscle decreases the neural drive to its antagonist.[27,41,101,102]

This latter inhibition results in a weakness in that antagonist muscle which can often be instantly strengthened by "waking it up" through stretching of the antagonist and proper activation of the agonist (inhibited muscle).

For example, a tight and facilitated psoas muscle can inhibit its antagonist, the gluteus maximus; but if the psoas is stretched and specific exercises are performed for the gluteus maximus, the inhibition will be changed into normal activation levels, which will last as long as the psoas is at a normal length.

This relationship is vital to functioning because of an antagonist's stabilization influence on a joint at the beginning of a movement[4]; if the antagonist is inhibited, then certain movements in the joint will not have the proper force couples (muscle recruitment patterns) and thus create a progression of problems, starting with altered joint mechanics and instability.

If the inhibition is a relatively new occurrence, then full strength can be regained quickly; but if it has been a chronic problem, then more time and an in-depth strengthening program are needed to restore strength.

Reciprocal Facilitation

This term has not yet been used (to this author's knowledge), but is an appropriate term for an already accepted theory and will thus be used in this manual.

Reciprocal facilitation is essentially the opposite phenomenon of reciprocal inhibition and describes the resultant tightness that occurs in a muscle (i.e. hip adductors) due to a weak antagonist (gluteus medius).

George Goodheart was the first to pioneer this theory (although he did not use the term "reciprocal facilitation") that a weakness can cause tightness in the antagonist. This concept is hard to grasp if one has always focused on treating the tightness, but it is important to understand that it is a basic concept of the body's innate protective mechanisms.

When a weak muscle contracts, it will force its antagonist (which should be inhibited by the contraction) to become more active in order to protect the joint from a ROM or position that cannot be stabilized by the weak muscle, eventually causing a

shortening in the resting length of the antagonist. This results in tightness and shortening of the antagonist, which can be confusing if the muscle is classified as a stabilizer and supposed to become inhibited in response to stress; i.e., hip adductors.

See pg. 9 for classifications.

Reciprocal inhibition and reciprocal facilitation can seemingly occur at the same time in the same joint; i.e., which came first, the chicken or the egg?

Seem confusing? It is. But hopefully the following thought will help.

Regardless of the cause, weakness or tightness, the corrective actions are virtually the same. The main goal is to balance tension around the joint. It is up to the clinical wisdom of the professional to figure out whether or not more time should be spent strengthening or stretching, but either way, both need to be implemented in order to have long-lasting effects.

The only exception is an acute situation or injury that can be resolved by simply relieving the disturbance.

See the ROM and Weakness section on pg. 41 for more on balancing tension surrounding a joint.

Synergistic Dominance

This occurs when a synergist compensates for a muscle that is weak or inhibited.[41,101,102] A common example is the hamstrings and erector spinae muscles synergistically dominating hip extension because the gluteus maximus is inhibited by a tight psoas muscle.

This leads to altered joint mechanics and muscle recruitment patterns which eventually cause injury and deterioration.

Arthrokinetic Inhibition

Takes place when a joint dysfunction creates muscular inhibition surrounding the joint.[101,102] The inhibition can be a result of altered mechanics or pain in the joint.

Reciprocal inhibition, synergistic dominance, and arthrokinetic inhibition can usually be corrected with appropriate strengthening and stretching exercises, but arthrokinetic inhibition sometimes requires surgery in cases where damage is present. Manual therapy is also important for correcting the above dysfunctions.

Correcting these types of imbalances is crucial for an exercise program, because if left alone, they can cause inefficient movement patterns and increased wear and tear.

For instance, Vladimir Janda[48] showed that *tight* erector spinae muscles are activated during sit-ups, and that stretching them before the sit-ups will increase EMG activity in the abdominals and decrease it in the erectors, therefore allowing a more efficient workout of the abdominal muscles.

Mental Influences

Negative thoughts or feelings can cause dysfunctional nerve impulses that decrease neuromuscular potential, and therefore physical functioning and well being.

Depression, anxiety, fear, anger, disgust, sadness, etc. are all emotions that produce a unique excitation, inhibition, pain, tightness, or altered muscle recruitment patterns and joint mechanics in areas that are related to the emotion.

For instance, many times when someone is injured they will store associated feelings in the area surrounding the injury as well as other places, and once the injury is healed, those feelings remain and maintain the sub-par functioning levels along with signs of pain that should already be gone. This is most obvious when an individual is not improving in pain or function levels but all signs of tissue damage and healing are improved.

It can be difficult to see mental influences on neuromuscular behavior, because during the assessment, the muscles can test strong or normal if the person's demeanor is relatively normal, but once they are in a negative state of mind, which can be triggered by specific people, thoughts, or activities, the neuromuscular system, in a way, short circuits in the areas related to the event, emotion, attitude, etc.

These short circuits can be detected by a trained examiner, i.e., through muscle testing and then brought to attention, if appropriate, and improved through positive reinforcement associations or cognitive-behavior therapy techniques.

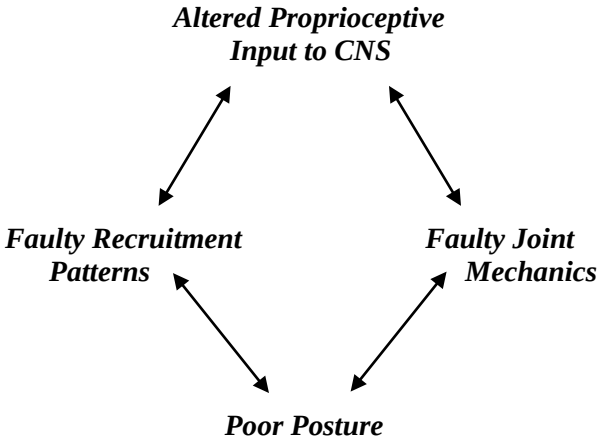
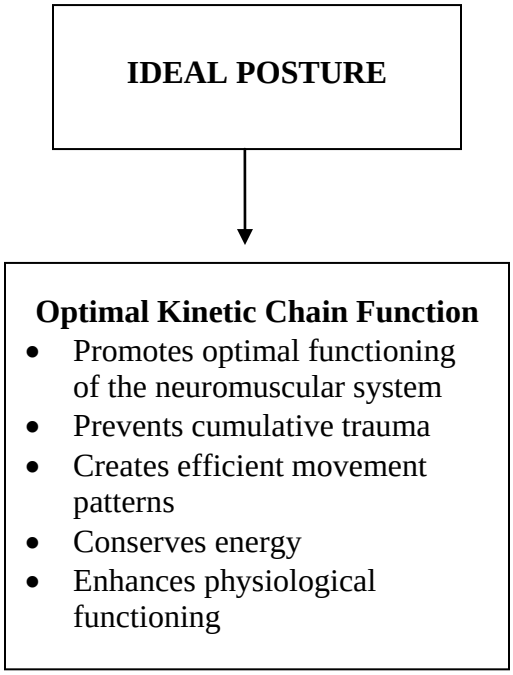


Fig. 1-1. Relationship between poor posture and the kinetic chain.

Muscular Reactions to Stress *(Go Back to Contents)*

This manual is geared for exercising, but not to the exclusion of mentioning influential factors regarding health and fitness.

Fig. 1-2 This above contains muscular and soft tissue reactions to dysfunctions in the body, mostly concerning the kinetic chain; many of them require manual therapy to correct their condition rather than self-stretching and corrective exercise.



It is important to learn and differentiate between the qualities of muscular dysfunction, because, according to Liebenson[41] "*Clinical decision making would be better served if muscle tension or stiffness is viewed as being related to either viscoelastic, connective tissue, and or neuromuscular factors*."

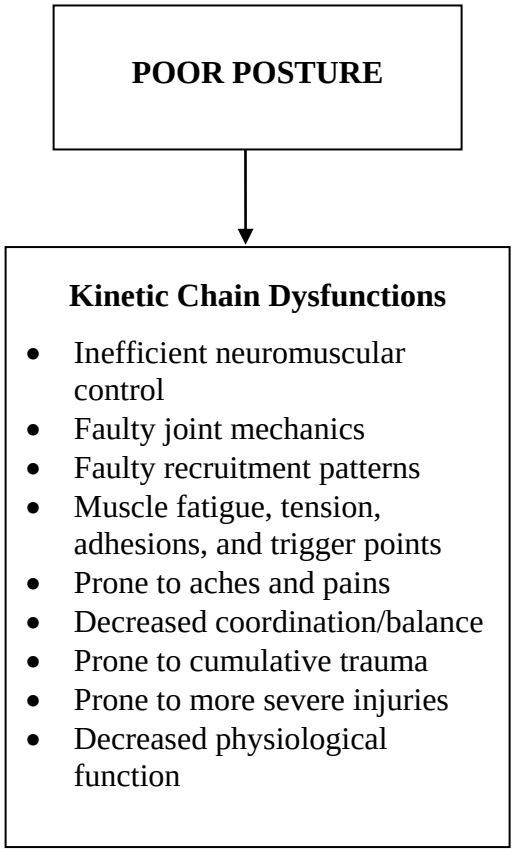
The following terms are grouped together, as they are commonly misused or misinterpreted. Although they have similar definitions, it is imperative to differentiate between their subtleties in order to learn their causes and recognize how to correct each one.

- Trigger point/Taut band/Adhesion
- Contraction/Contracture/Spasm
- Short/Tight/Taut/Hypertonic/Facilitated
- Weak/Elongated/Inhibited

Trigger Point

The following description is based on the brilliant work of Travell and Simons[7,8] and barely scratches the surface of the knowledge and treatment of trigger points (TP's).

TP's are tender nodules in soft tissue within a palpable taut band that elicit a distinct referred pain pattern if digital pressure is applied or they are aggravated enough.



TP's create an environment in the muscle which makes it: 1) more susceptible to fatigue, 2) facilitated and overactive, or 3) inhibited, 4) hypersensitive to pain, 5) shortened and painful in response to stretching.

Evidence indicates that TP's can transmit their influence (facilitation, inhibition, spasm, tension, etc.) to other muscles throughout the kinetic chain by way of the CNS, especially if those areas already house TP's.

TP's are formed when stress or trauma creates a dysfunction at the motor endplate and damages the sarcoplasmic reticulum, causing it to release excessive calcium that signals the release of excessive acetylcholine in the synapses. This event cycles on and creates a sustained sarcomere shortening (contracture) which leads to an energy crisis in the muscle fiber.

The contracted muscle fibers require energy to allow the muscle to relax (ATP molecule binds to myosin head to facilitate cross-bridge detachment), and so because of the constant tension and energy usage created by a TP, that sarcomere remains in a state of contracture, which can only be relieved by improving the TP.

TP's are formed once adequate physical (cumulative or acute trauma) or physiological (nutritional deficiencies, allergies, and more) stress is placed on a muscle. They can be dormant or active, both of which can cause referred pain, but an active TP will refer a familiar pain that the person has been experiencing recently.

Treating TP's is done with a variety of methods, such as postisometric relaxation techniques (PIR), ischemic compression, and many other manual therapy techniques that are described in great detail in the Myofascial Pain and Dysfunction manual's[7,8] and the two volumes of Clinical Applications of Neuromuscular Techniques.[4,11]

Applying each technique depends on the location of the TP, which can be towards the middle (central TP) or at the attachment of a muscle. Stretching can aggravate attachment TP's but inactivate central TP's. It is recommended to release any central TP's that are on the same taut band as an attachment TP before addressing that attachment TP.

Taut Band

A taut band is a palpable cord that consists of a group of muscle fibers, oftentimes housing a TP somewhere along its course, which ultimately ends at the muscle's attachment site, although, taut bands can be found in normal muscles.[7]

Taut bands are treated, if accompanied by a TP, by treating the TP. This should be distinguished from a taut muscle, which is not necessarily related to TP's.

Adhesion

Adhesions are formed by unorganized fibrous cross-linking, i.e., scar tissue, and can be found in ligaments, muscles, fascia, cartilage, or tendons.[40] They are formed when joint degeneration, prolonged immobilization, or trauma occurs[40], or when tissues can no longer tolerate the cumulative stresses placed upon them.

Myofascial and articular adhesions can greatly reduce ROM as well as cause pain with certain movements. Myofascial adhesions limit soft tissue pliability and can directly spread their restrictiveness along the entire kinetic chain by way of the myofascial meridians, which connect from head to toe. For more details on myofascial meridians, see the Kinetic Chain Anatomy manual.

Improving or eliminating adhesions is short lived if the process by which they are formed is not also corrected. Once the source is dealt with, adhesions can be treated with PIR techniques, manual therapy, and manipulations.

Contraction

Contracture, contraction, and spasm all involve muscle contractions, but only a contraction is voluntary and controllable. Most functional movements utilize contractions, both subconsciously (eyes blinking, breathing, postural adjustments, etc.) and consciously (sports, dancing, cooking, etc.). Contractions are the only normal occurrence listed here and are necessary for daily functioning.

Contracture

Contractures result from two different situations, both resulting in decreased ROM and strength potential. One is from soft tissue shortening due to fibrosis[7,8], which can occur from chronic adaptations to kinetic chain distortions or traumatic injuries. The other is more complicated and involves an *involuntary muscular contraction that remains in a state of constant contraction in the absence of action potentials*; the contracture seems to be maintained by a neuromuscular dysfunction at the motor endplate of the muscle fiber and is thought to be a product of TP's.[7,8]

The presence of a contracture or palpable taut band is therefore significant to exercise programming due to the probable existence of a nearby TP which is causing multiple dysfunctions, interfering with exercise and function. Treating a contracture is recommended before performing complex exercises and is done with PIR techniques and manual therapy.

Spasm

Spasms are like a contraction in that they involve action potentials that increase tension with or without muscle shortening, but they differ by their involuntary nature.[7,8] They usually act as a protective mechanism that attempts to restrict movement surrounding an injured or diseased area. This type of spasm responds well to placing the protected tissues in a resting position[4] and resolving the underlying issue.

Another form of spasm is a referred spasm induced from TP's. This referred spasm is more likely to occur

in muscles that already harbor TP's or in certain susceptible muscles (lumbar paraspinals, upper trapezius, masseter, and posterior cervicals) and is independent of referred pain patterns.[7] Contractures and spasms can occur in nearby tissues.[4]

Treating a spasm should only proceed once its cause is known. Treatment for a *protective* spasm, which can look and feel just like a TP spasm, should not focus on the spasm, it should be aimed at improving the cause; otherwise the protected tissues will become vulnerable; i.e., underlying disc herniation or hypermobile joints.

Treating a referred or TP spasm, however, is done effectively with PIR techniques[7,42] and or TP release and manual therapy, but only if it is clear that no acute underlying issues are present.

Short

Short muscles are just that, short, although figuring out why they are short can require great skill. A short muscle will feel tight if it is in a constant state of semi-contraction. Short muscles are prone to tightness, weakness, TP's, and contractures, and are accompanied by their elongated and weak antagonistic muscles. This combination creates immediate joint imbalances and more wide-spread distortions throughout the entire kinetic chain. Chronically shortened muscles eventually become weak in what Janda[115] calls "*tightness weakness"*; i.e., the psoas or quadratus lumborum.

A short muscle's length is limited by numerous influences that range from the muscular reactions mentioned in this section (contractures, spasm, etc.) to genetic deficiencies and compensating for distant or nearby kinetic chain imbalances. A short muscle's strength can appear greater than normal if it is only tested in its shortened position but will show signs of weakness if tested for endurance, coordination, or after briefly lengthening it.

How to lengthen short muscles depends on the condition of the muscle and its surroundings. It can take quite an investigation to figure out if the antagonist needs to be strengthened or if simply stretching the short muscle will improve both the short and elongated/weak muscles.

See ROM and Weakness section on pg. 41 for details about weaknesses limiting ROM.

If the short muscle is in combination with other factors, i.e., is facilitated, tight, weak, has contractures, etc., then additional strategies should follow the guidelines mentioned for each additional factor.

Tight

Muscle tightness leads to loss of flexibility and produces palpable sensations that are similar to stiffness, firmness, rigidity, and tautness. It is a general term that relates to tissue which is dysfunctional and prone to TP's and contractures and often requires a thorough examination to figure out the cause of the tightness. Tightness alone is not a good indicator for specific treatment plans, because it is present with numerous types of dysfunctions; therefore, other observations are needed, along with the presence of tightness, to deduce a treatment plan.

Taut

Using the words of Kendall and McCreary[49], "*Taut* means stretched out fully, not slack."

If a muscle becomes taut before reaching its normal ROM limit, then the muscle is short. It is not unusual for a muscle to palpate as tight or rigid without being taut; i.e., the upper trapezius and erector spinae. This definition should be distinguished from "taut band."

Hypertonic

Hypertonic muscles exhibit excessive tone and tension that is visibly noticeable. Unfortunately, it is just like tightness, in that it is only a sign of dysfunction that requires further examination in order to discover the reasons for the hypertonicity.

Facilitated

Muscles that are facilitated tend to be overactive and dominate movements in which a related synergist or antagonist is weak/inhibited even if the movement is not the muscle's main duty.

Facilitation can be spread throughout the kinetic chain to various regions of related function and requires special training to correct it due to the Law of Facilitation.

Common interactions of facilitated and inhibited muscles, along with their corrective actions, will be mentioned throughout the manual.

Weak

Weakness can be due to neurological (nerve root compression or peripheral entrapment), disuse atrophy, anatomical (length/tension relationship) and or neuromuscular factors (inhibition). Weakness is related to muscle length abnormalities and will lead to joint instability and antagonistic tightness in the surrounding area, eventually spreading compensation throughout the

kinetic chain. Its treatment depends on its source, which can be in distant or nearby dysfunctions.

See the Correcting Tightness and Weakness section below for details on corrective actions.

Elongated

Elongated muscles are the opposite of short muscles in regards to length but are associated with myofascial tension, as are short muscles. The difference is, a tense elongated muscle usually produces a noticeable weakness compared to a tense short muscle.

The complex interactions of the surrounding muscles and influential areas of the kinetic chain need to be understood before planning a corrective actions program for elongated muscles.

Inhibited

Inhibition here refers to decreased neural drive to a muscle and seems impossible without facilitation of the antagonist. Inhibition causes weakness in the muscle that can be quickly improved with specific exercises if the weakness is relatively new, or it can take much longer if the (Law of Facilitation) has settled in. Inhibition can also be referred from distant TP's.[7]

Correcting inhibitions is, once again, done most effectively by utilizing the interactions of the kinetic chain to find the key influences. Once it is certain that the inhibited muscle needs to be strengthened, specific activation techniques can be used to "jump start" the neuromuscular connection to the muscle. This will speed up the strengthening process and encourage proper utilization of the muscle for specific unassisted strengthening exercises.

Correcting Tightness and Weakness

Many people adhere to the principle of shortness/tightness causing weakness/elongation of a muscle, but George Goodheart, DC (the "father" of applied kinesiology), had incredible success treating muscle tension by simply strengthening the weak antagonists of tight muscles; therefore, showing that weakness can cause tightness.

It is dependent upon the belief of the professional as to which strategy should be used for correcting tight or weak muscles; either focusing on stretching tight muscles or strengthening weak muscles.

It is useful to note that both strategies seem effective if applied to the appropriate situation; in other words, sometimes weakness/elongation is a priority, and other times tightness/shortness is a priority.

Always remember however that true weakness in a muscle is not improved by stretching its antagonist.

Muscle Classifications *(Go Back to Contents)*

The exercise philosophy of this manual is largely based on the classification of muscles and can be summed up with two main principles:

1. There are three types of muscles: global and local stabilizers, and mobilizers. Each can be placed into one of two categories: 1) hypoactive, 2) hyperactive.
2. These muscles must be activated and strengthened in a progressive order; otherwise the larger muscles will dominate the smaller ones and create instability altered activation patterns.

Many great minds[59.60,61,138,139,140] in the past have contributed to the evolution of classifying muscles, and to this day there is still disagreement on one classification system that fits all. There has been more confusion with the naming of the classifications than the actual functions for each group of muscles.

For instance, it is generally agreed that the hamstrings have a tendency to shorten or tighten when chronically stressed, but they are labeled as postural muscles by Janda[61], which seems confusing, due to the fact that they are electromyographically silent during quiet standing, on one or two feet [99,142]

This author combines the compatible theories into *two* similar classification systems that are helpful for figuring out the corrective actions and common tendencies for specific muscles and groups of muscles throughout the kinetic chain.

Depending on how the body is constructed (everybody is different) and how it is habitually used determines the complex interactions and compensations within the kinetic chain; and because most people are designed similarly and participate in general activities, there is a list of common tendencies for certain muscles. See Box 1-2 and Fig. 1-3.

These classifications can be combined to form one set of guidelines to be used for evaluating the muscular system.

As seen in Box 1-2 and Fig. 1-3, muscles can be classified by dysfunction (hypo-hyperactive) and function (stabilizer/mobilizer). While each is related to the other, stabilizers are usually hypoactive, and mobilizers are usually hyperactive.

Classifications of Muscle Groups "Stress Response" (Go Back to Contents)

Box 1-2

Hypoactive Group	Hyperactive Group
Usually stabilizers	*Usually mobilizers*
Tend to weaken/lax	*Tend to tighten/shorten*
Fatigues easily	*Predominantly used*
Prone to inhibition and delayed activation patterns	*Prone to facilitation*
	Prone to TP's first
	Increased resting tone
Requires special training	*Spasm in response to pain*
Dominated	*Dominate*
Arm extensors	Hip adductors
Deep cervical stabilizers	Arm flexors
Deep erector spinae	Erector spinae
Deep neck flexors	Gastrocnemius
Gluteals	Hamstrings
Infraspinatus	Latissimus dorsi
Internal oblique	Levator scapula
Middle/Lower trapezius	Pectoralis major (upper)
Multifidus	Pectoralis minor
Paraspinal muscles (not erector spinae)	Piriformis
	Psoas
	Quadradtus Lumborum
Pectoralis major (lower)	Rectus femoris
	Rectus abdominis (upper)
Peroneals	Soleus
Posterior deltoid	Sternocleidomastoid
Psoas major (posterior fascicles)	Teres major
	Tensor Fascia Lata
	Upper trapezius
Rectus abdominis (lower)	
Rhomboids	
Serratus anterior	
Teres minor	
Tibilalis anterior	
Tibialis posterior	
Transverse abdominis	
VMO	

This box is a combination from Norris[59], Jull and Janda[60], Janda[61], and Chaitow and DeLaney.[4] Some of the muscles (scalenes, external obliques, and others) are not agreed upon and will therefore be left out. It is possible for muscles to start as one type (hyper or hypoactive), and then evolve into the other type if sufficient demands are placed on it from faulty postures; i.e., the scalenes.[4, 41]

These classifications are, of course, guidelines and not finite rules. Certain muscles, such as the Q.L. and oblique abdominals can act as two different groups (global stabilizer and mobilizer) depending on the situation and fibers used.

Based on this and other evidence that shows how different muscles respond to various stresses, Exercise Progression uses a systematic approach to improving the function and interaction of the muscular system by activating each muscle type in order from deepest to most superficial, or from most stabilizing to most mobilizing. See Chapter 14 for details on progressions.

Stabilizers

A. Local
B. Global

Local Stabilizers

These are mostly deep, small, medially located, segmental, and slower acting endurance muscles that function best in weightbearing postures to maintain joint stability (multifidus, transverse abdominis, interspinales, etc.).[138]

When deloading occurs (decreased weightbearing and sensory input regarding gravity; i.e., sitting, lying, swimming, etc.), the local and global stabilizers tend to atrophy and lose function while the mobilizers hypertrophy. This also leads to less sensory input and, therefore, decreased proprioceptive ability.[138] This may take a lifetime to build up, but its immediate influence is evident once someone tries to perform a balancing exercise after prolonged sitting or lying.

Weakness in these muscles facilitates the over-utilization of the mobilizers and therefore instability. This is a common root of kinetic chain dysfunction due to the common tendencies of society; i.e., sitting, lying, and focusing on physical appearance (arms, chest, back, legs, and other mobilizers).

It is important to notice that the stabilizers and mobilizers tend to respond to pain and dysfunction in opposite manners.

The corrective actions for weak local muscles are to start at ground zero by isolating them and learning to activate them slowly and statically in a variety of positions. This is best done in the absence of other complex exercises; otherwise the hyperactive mobilizers will take over and inhibit the local muscles.

Eventually these isolated actions will be integrated into more functional motions, as in Stage II of Exercise Progression, global stabilization.

Global Stabilizers

The global muscles are similar to the local muscles but differ by being more superficial, larger, and involved

with stabilizing *areas* of the body rather than individual segments. They have the same characteristics as the local muscles but utilize more integrated corrective actions, such as weightbearing while utilizing the local muscles to achieve proper joint alignment and stability throughout more functional movements.

Mobilizers

The mobilizers are constantly overactive and trying to manage the duties of the smaller and underutilized muscles, which is a problem because they are not equipped to do so. Their main functions are to create gross movements and co-activate against heavy and unexpected loads in order to enhance stability. Mobilizers are fast-acting muscles that tend to dominate quick, gross, and open chain movements unless trained otherwise.

Corrective actions for these muscles are the initial training of the stabilizers in a closed-chain environment so that gross movements can be performed on a stable body. Then the integration of mobilizers can begin by utilizing faster and larger movements (open and closed chain) while maintaining proper alignment.

Although many of the muscles have not been clinically tested for their weightbearing or non-weightbearing capabilities, these classifications of muscles are helpful for keeping the big picture in mind and knowing where adhesions and trigger points are likely residing, as well as which muscles need to be strengthened and stretched, and how to do so.

It is essential, however, to figure out why these dysfunctions are happening; otherwise results will be short lived.

CNS Control of Lumbopelvic Stability

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The central nervous system (CNS) has a tremendous variety of afferent sensory input to interpret in order to maintain stability and efficient movement throughout the body in relation to various situations, as well as numerous pre-programmed muscular interactions at its disposal developed for certain predictable occasions.

The neurological loops involved with motor control of trunk stability will be discussed and generalized here, while their complex neural interactions within the CNS left out of the discussion. There are three main loops that the CNS uses to control motor function throughout the trunk muscles:

1. Feedforward control
2. Feedback control
3. Postural control

Feedforward Control

Feedforward neurological loops are activated in order to stabilize the lumbopelvic area *prior* to *predictable* imposed demands on the trunk.[138] In these situations the CNS predicts the forces that are about to affect the body and dispatches a coordinated neuromuscular plan of attack to neutralize these external stresses. This plan is based on past experiences similar to or equal to the present situation and will stabilize the body appropriately in normal subjects.[138,179,180]

These “planned attacks” utilize different muscles and come in waves of activation, each within milliseconds of one another, and have a unique functional goal.

According to Richardson, et al.,[138] there is a hierarchy of spinal control:

1) Intervertebral translation and rotation
2) Spinal posture and orientation
3) Body control in relation to the environment

Supporting this hierarchy are the following findings and ideas regarding the presence of an inner muscular unit within the lumbopelvic stabilizing system that activates together in unique ways, prior to and during predictable imposed demands.

- The diaphragm[181] and transverse abdominis (T.A.) had tonic or relatively constant activation throughout repetitive arm movement, while the erector spinae had intermittent activation.[172,182]
- The T.A. and diaphragm activate prior to movement as a spinal stability mechanism.[178]
- Intra-abdominal pressure (IAP) and T.A. and diaphragm activity increase in proportion to the velocity, and therefore force, of the reactive moment during repetitive arm movement.[172]
- T.A. activation levels are linked to the intensity of control needed to stabilize the spine.[138]
- When electrically stimulated, the diaphragm can 1) generate a minor extensor moment,[188] 2) increase spinal stiffness against posteroanterior forces, especially at the higher lumbar levels[189,190], (due to the direct attachment of the diaphragm to the upper lumbar vertebrae).
- Although it is difficult to assess, it is plausible that the pelvic floor muscles have a similar effect on spinal stability as the diaphragm.[138]

The T.A. and pelvic floor muscles were the main muscles activated while forming a neutral spine position.[183]

- The T.A. and pelvic floor muscles are often activated as a team.[138]

- The diaphragm and pelvic floor muscles' main role in spinal stability is to create IAP in coordination with the T.A. and restrict movement of the abdominal contents so that the lumbar dorsal fascia (LDF) can be properly tensed.[138, 172,178,181,186]
- Tonic activity of the pelvic floor muscles has been documented during repetitive arm movements.[184]
- The T.A. and multifidus activate independent of the direction of the reactive forces placed on the spine[150,151], as opposed to the direction specific activation of the mobilizing muscles.[150,152,153] This suggests that the T.A. and multifidus are part of the inner unit and feedforward neuromuscular system used to counteract intervertebral instability due to non-direction-specific forces.[138]
- Deep multifidus activity is tonic during repetitive arm movement and in upright postures.[151]
- Multifidus has tonic activity during walking.[187]

- The internal oblique abdominals were activated prior to the deltoid during arm abduction and extension.[176]

It is evident that, during predictable movements, the CNS utilizes an initial activation of an inner unit or local stabilizers to stabilize intervertebral movement, followed by more global stabilizers to control spinal posture and orientation, and finally, or sometimes simultaneously, by mobilizers to prepare the body for predictable situations. See pg. 15 for details on individual muscles of the inner unit.

These naturally coordinated waves of activation are a main goal of Exercise Progression and are best established by 1) eliminating major imbalances and pain, 2) beginning with simple activation exercises and incorporating them into daily functioning, 3) progressing to more complex and faster actions.

Feedback Control

Feedback loops are much simpler than the feedforward loops and rarely, if ever, reach the brain. They consist mostly of simple reflexes, such as the stretch reflex, and are activated in response to unpredictable movements that force the CNS to take action quickly, usually resulting in muscular coordination that involves all influential muscles activating at the same time, deep and superficial.[138]

This type of reaction to the environment can only be trained for once proper feedforward loops have been established; then utilizing increased velocity and unstable surfaces is an appropriate way to train the body for slips, falls, etc.

Postural Control

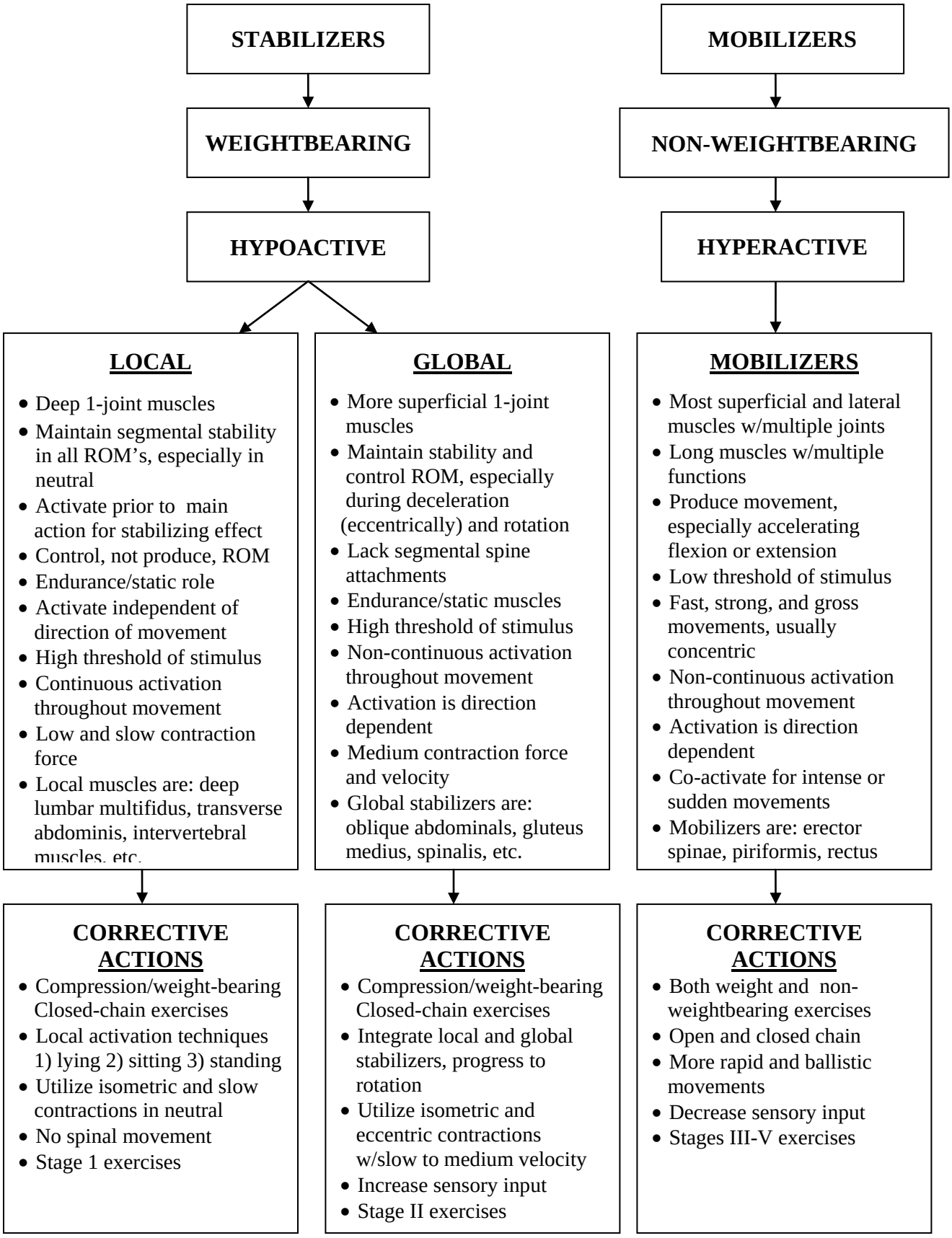
Postural or tonic control is based on both feedback and feedforward control mechanisms and is in charge of 1) antigravity tonic/postural system, 2) stabilization before movement.[138]

The antigravity system regulates the tone and stiffness of specific postural muscles in order to stabilize the joints, while the "stabilization before movement" system is the same as the feedforward control system mentioned above.

Muscle stiffness controls the forces surrounding joints and prepares/stabilizes them for upcoming stress, even before stretch reflexes.[192] Similarly, trunk stability may be linked to the stiffness of the spinal muscles.[138]

All the complexities of the CNS are not yet understood, such as how, when, and if the different control systems work simultaneously, but the possibility cannot be ignored.[138]

Functional Classifications of Muscles (Fig. 1-3) (Go Back to Contents)



Proper Muscle Activation Patterns (PMAP)

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PMAP is similar to, if not the same as, *force couple relationships* and is founded on the principal listed in Box 1-3.

PMAP is only possible if the CNS is properly utilizing all three types of motor control systems (feedback, feedforward, and postural) for lumbopelvic stability.

Box 1-3

> Just about every planned movement should *begin* with a *natural* tensing of the CORE, followed by global stabilization; both in proportion to the forces needed to stabilize the spine and occurring prior to the movement.

Appropriate activation patterns for feedforward control rely on correct postural control of stiffness, while appropriate activation patterns for feedback control rely on precise control of the feedforward system.

In other words, proper movement patterns are based on ideal posture, and efficient reflex arcs are based on ideal posture and normal movement patterns.

According to many studies, the T.A. activates prior to the muscle responsible for the main movement (arm or hip flexion, etc.) and continuously throughout the movement in normal subjects[173-178], while activation of the T.A. is delayed in those with low back pain.[176,177,178]

The pelvic floor[184] and diaphragm also activate prior to and continuously throughout movement.[138,172,178, 181,182,183] This is evidence of the ideal neuromuscular *feedforward* system mentioned by Richardson, et al.,[138] that allows the CNS to control lumbopelvic stability in advance of imposed *predictable forces* with a preprogrammed set of muscular contractions and interactions, which follow the guideline of: the more velocity or stability required, the sooner and greater the abdominal mechanism will activate.[150,172]

Properly activating the inner unit prior to movement or an imposed demand places the body in its strongest and most efficient position, thereby promoting optimum functioning throughout the rest of the kinetic chain.

See pg. 80 for details on abdominal wall activation patterns in spinal stabilization.

Strength starts from within (the center) and then moves outward following the nerve impulses towards their targeted action.

It is noticeable when someone "flows" properly; they have a smooth and natural rhythm. For example, many great athletes have that natural flow.

Even something as simple as lifting a bag of groceries should follow a pattern; the lumbo-pelvic stabilizers, legs, chest, shoulder, and upper arm should activate in that order before the forearm lifts the weight.

If the groceries are lifted before the stabilizing muscles activate, the body will buckle at its weakest links instead of dispersing the tension throughout the "team."

Normal firing sequences (PMAP) for most movements against resistance should be:

1. *Natural* tensing of the abdomen (inner unit - local stabilization)
2. Stabilizers of proximal joints and legs (gross stabilization)
3. The agonist of the movement (outer unit - mobilization)
4. The synergists and stabilizers of the agonist will vary with their timing depending on the direction, speed, and resistance of the movement.

Injuries and pain are known to cause altered patterns of movement due to muscle compensations; this is one reason that *low back pain is one of the greatest predictors of future low back pain.*

Another source of altered recruitment patterns is faulty static or dynamic posture, which creates the same problems as pain, such as: altered joint mechanics, reciprocal inhibition and facilitation, synergistic dominance, and arthrokinetic inhibition throughout the affected areas. These are corrected through the five steps mentioned below.

PMAP is fundamental to obtaining maximum efficiency during simple and complex movements and can be achieved by:

1. Releasing any trigger points, manipulating joints, and releasing tension and pain in the affected and influential areas.
2. Learning to properly activate the abdominal wall and multifidus.
3. Correcting posture by balancing muscle tension around the joints and throughout the fascia network in order to eliminate any neuromuscular dysfunctions.
4. Starting with simple and isolated exercises geared towards stabilization and balance.
5. Progress to complex movements that coordinate the neuromuscular system to efficiently function in all three planes using all three types of contractions (concentric, eccentric, and isometric) along with acceleration and deceleration of movement.

If PMAP is learned, it will reduce future damage to the body and spine, thereby decreasing the intensity and frequency of future problems.

Keys for PMAP training are:

- Know which muscles are involved with the action and where they lie in the body.
- Know what order they should fire in and the appropriate level or intensity of contraction for each.
- Visualize these patterns (where and when they activate) during PMAP training.
- The practitioner can pat the person's stomach while they are exercising to confirm and reinforce the stiffness.

➢ See the muscle testing section in Ch. 12 for assessing important PMAP.

The CORE *(Go Back to Contents)*

The CORE has been defined as many different things in the past, and here's yet another description as defined by this author. *The CORE is three groups of muscles that function together to stabilize and mobilize the lumbar spine and trunk about the pelvis.* It follows the principles mentioned above relating to the three waves of activation and three types of motor control systems.

See fig. 1-4 for more on the CORE.

Figure 1-4 is merely a schematic to help visualize the CORE and how it functions. It is by no means a complete picture. There is much to learn about the CNS and its complexities regarding control of posture and the variety of interactions with the environment.

Classification of Muscle Dysfunction

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Classifications of the causes of dysfunction or "non-serious pain syndromes" are described in more detail in Chapters 2 and 12 and will only be briefly mentioned here.

In order to significantly affect a dysfunction, its source must be found and corrected. Three main sources are:

1. Kinetic Chain
2. Physiological
3. Psychological

This is similar to the model used by Chaitow and DeLaney[4,11] to describe the negative influences on a patient's health, which they classify as biomechanical, biochemical, and psychosocial.

Only the physical component (kinetic chain) will be dealt with in this manual, although some notice is given for the other two throughout the text.

A similar way to look at physical symptoms is by integrating all aspects of life, as in the following formula.

M + E + S = P

M = Mental E = Emotional S = Spiritual P = Physical

This equation shows that our physical self is a manifestation of our inner workings. In other words, "the roots feed the fruits" or "the invisible effects the visible." If one component on the left side of this equation is struggling, then the physical body will manifest symptoms corresponding to that precise struggle.

It is important to know when a non-physical component is affecting the physical body so that the appropriate referral can be made and time is not wasted on inappropriate or even harmful physical strategies.

Health vs. Fitness *(Go Back to Contents)*

The following definitions are as described by the Merriam-Webster's Collegiate Dictionary:[76]

- Health - "the condition of being sound in body, mind, and spirit; *esp* : freedom from physical disease or pain"
- Fit - "sound physically and mentally: Healthy"
- Fitness - "the quality or state of being fit" and "the capacity of an organism to survive and transmit its genotype to reproductive offspring as compared to competing organisms"

It is easy to see why fitness becomes associated with health but oftentimes does not truly promote it.

The above definition of "fit" leaves out the spiritual dimension but is still considered "healthy," while the fitness definitions are based on the degree in which one is fit and competing with others.

These definitions, which are probably the most accepted in society, show that health is three dimensional but fitness is only two dimensional, and if someone has a high level of fitness, then they must be fit and, therefore, healthy.

This type of fitness health is driven by the mind, and without getting too philosophical, is lacking a spiritual component that keeps the body in line with true health as opposed to fitness health.

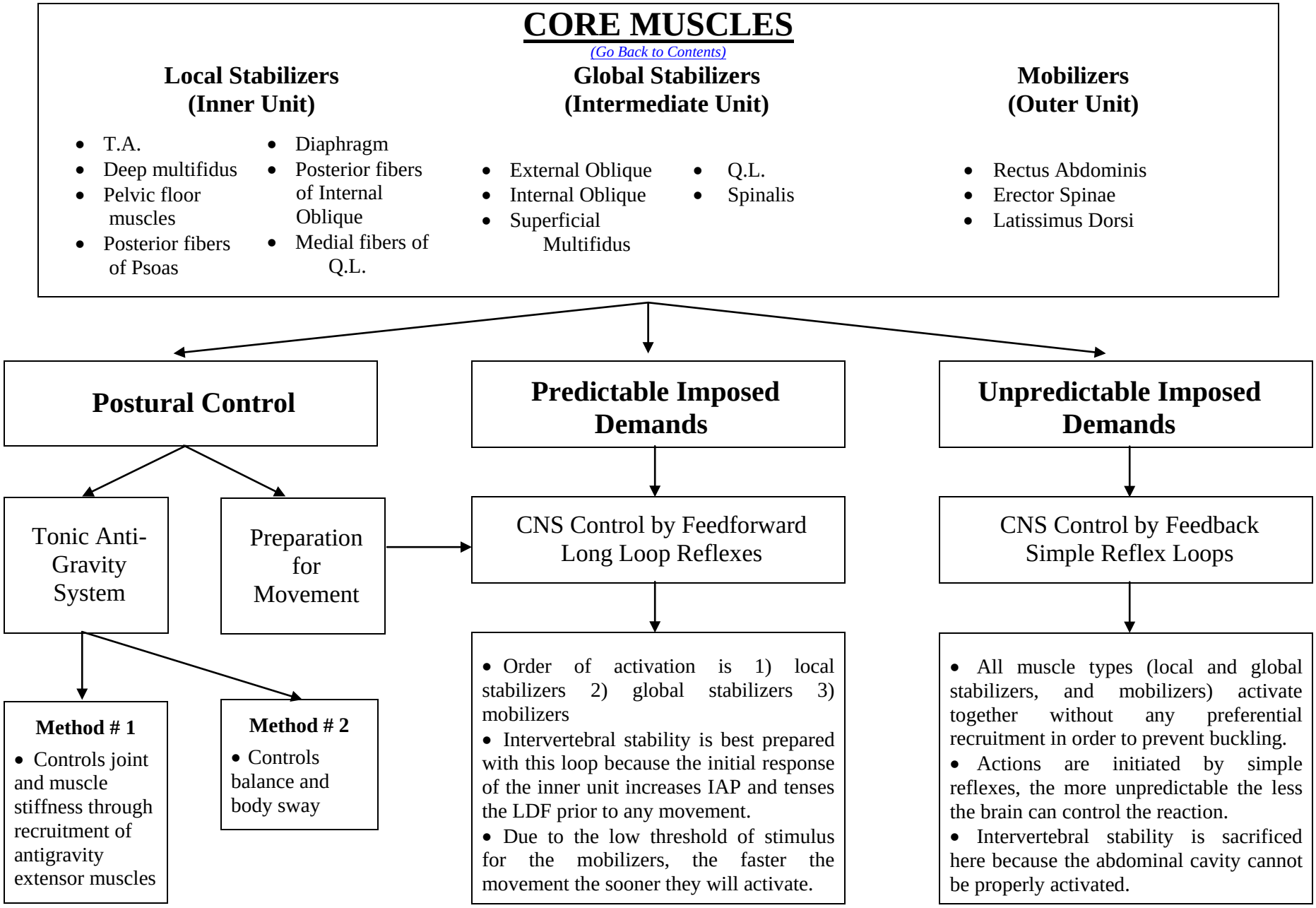


Figure 1-4 - *The CORE muscles and the different mechanisms of control utilized by the CNS during various situations, modified from Richardson et all[138] and Massion.[193]*

The main difference is not spiritual awareness, which is a bonus, but rather enjoying the pursuit of health instead of pursuing results from fitness.

It is rare to find someone who works out the appropriate amount for their body. Most often people exercise too much or not enough, usually out of ignorance or simply ignoring the body's needs; i.e., exercising for the wrong reasons or not exercising due to low health priorities.

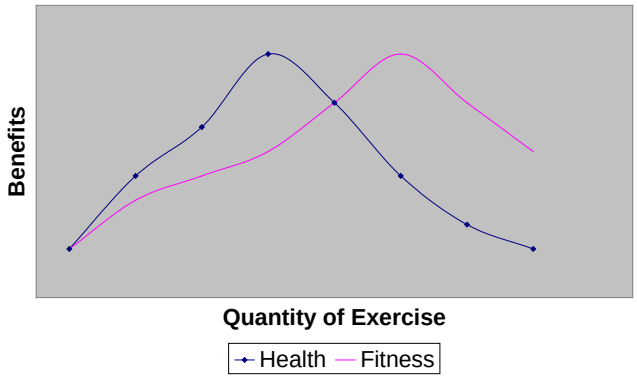
Ignorance can be helped through education about the relationship and benefits of health and fitness, but ignoring is a much more complex issue that will not be addressed here, although education can influence a change in motivation.

It is a goal of this manual to encourage health instead of fitness training whenever possible, but it is also this manual's goal to teach athletes and those who are physically active to find a balance between extreme training and health training, and therefore both types (fitness and health) of programs will be described along with ideas about how to alternate between the two.

Health is always in flux and thus requires constant adjustments through nutrition, movement, intensity, and thought process.

There is a point where the amount of exercise or activity is detrimental to health. See graph below.

Health vs. Fitness



Graph notes:

1. Optimum health requires less exercise than optimum fitness.
2. Too much exercise can be just as detrimental as little or no exercise.

Exercise Goals

- **Health** - To stress the body in a way that encourages *all* of its systems to function most efficiently.
- **Fitness** - To stress the body in a way that achieves specific external results (aesthetics, speed, strength, endurance, etc.).

These two goals can have very different impacts on the body, but ideally they complement one another.

When exercising for health, there is no such thing as a bad workout unless an injury or overtraining results. Understanding this perspective makes it easier to avoid the disappointment of failing to achieve or overexertion to gain specific results (weight, time, repetitions, etc.).

When exercising for fitness, the body's internal functions are often sacrificed to reach external goals. Exercising at too high of intensity and or for too long a time can drain the entire body of its vitality, which can be replenished if treated appropriately, but will eventually have long-term negative effects on overall health if this type of training is habitual.

Unfortunately, those who train at this level either do it on a consistent basis, which doesn't allow enough time for revitalization and speeds up wear and tear, or do it infrequently, which often results in injuries.

These people can look healthy on the outside, but to an experienced observer, their body's systems are noticeably inefficient.

A few things are needed if health is a goal.

1. Patience
2. Knowledge of appropriate exertion levels (mostly intuitive)
3. Understanding that health relies on fitness more than fitness relies on health.
4. Realizing that *health is a state of being* and *fitness is being in a physical state.*

In order to obtain health, the ego must be left out of goal making. The ego wants to protect and maintain the self-image it has created throughout a lifetime.

Examples of some ego images and goals are:

- Looking good (compared to others, of course)
- Being good at something (compared to others, of course)
- Achieving a physical goal, even at the expense of health.

These goals are accepted and encouraged by most of society because of one main idea: succeeding or wining for whatever it takes.

This may be necessary to seriously compete in athletics or extreme activities, but it must be realized that these two examples do not promote health and should not be participated in unless the relationship between health and fitness is understood and accepted.

A wise person will have the ability to achieve both health and fitness goals at the same time. Some example goals for health are:

- Lower resting heart rate, blood pressure, body fat (if obese), and have more daily energy.
- Train for an event, i.e., marathon, race, sport, etc, to the best of my capabilities while listening to my body for signs of overtraining and not be disappointed if I can't compete, because the goal was to train to the best of my capabilities, not achieve results.

With all of this being said, it is possible to be *relatively* healthy if extreme training, like most athletes, is properly utilized.

The point to be made here is that extreme training is not necessary to become healthy, and it is associated with less than optimal health.

The choice is simple; live for the mind (external results), or live for the body (internal results).

Pain and Exercise *(Go Back to Contents)*

In general, if someone has pain or an injury, it is recommended to get their doctor's clearance and advice for exercise before starting an exercise program.

Pain will cause faulty patterns of movement and muscle recruitment in the surrounding areas and eventually create dysfunction throughout the body. Therefore, *people with pain should avoid complex movements or intense exercise because they lack the coordination to properly stabilize the body.*

Even if the body can normally perform a difficult exercise with ease, that exercise is potentially dangerous once the body is in pain. This is very difficult for the mind to accept if health is not the main goal of exercising.

Sometimes during the post-rehabilitation phase of an injury, or even throughout a lifetime, slight pain will be inevitable with or without exercise. Then the goal is as much functional exercise as tolerable so the body can better handle daily (housework) and not so daily (skiing) activities.

The following guidelines were established by the American Academy of Health, Fitness and Rehab Professionals (AAHFRP)[5] and are useful for determining who should and shouldn't workout with pain.

On a scale of 1-10, if pain is:

- 1-3 Exercise may be tolerable
- 4-5 Activity should be modified
- 6-10 Stop activity

Stress can be physical or mental, and the more the body is "stressed" with exercise (in a productive manner), the more prepared it will be to combat the stresses of everyday life, including mental and emotional stress.

Improving Injuries *(Go Back to Contents)*

There are a number of ways to improve during a post-rehabilitation exercise program. One is by coincidence, which happens from doing exercises and activities that don't irritate or directly affect the injury and, therefore, let the body heal by using its own internal resources.

Another way is from utilizing exercises that correct or positively influence the injured structure and its surroundings, not necessarily by focusing on the injured area. This way can also speed up recovery time compared to "coincidence" as well as correct the imbalances that cause re-injury.

Improvement should be based on pain levels and daily functioning more than how much or how many times a weight can be lifted.

If gym strength increases but ease of daily living doesn't, different exercises are needed. Determining who should be challenged with exercises and who should go easier is an important factor and delicate balance.

The feeling of accomplishment rather than being overwhelmed with exercise can be the deciding factor in improvement, mentally and physically.

Exercise naturally causes some discomfort and irritation. If the tissues being exercised are already irritated, then a lot of discomfort will obviously follow. If this response can be minimized to 2-3 days while functional ability is maintained, then the workout was a success.

Obviously, individual tolerance levels must be kept in mind, but sometimes, with some education and encouragement, healthy tolerance levels can be increased.

Progressing *(Go Back to Contents)*

The progression variables described in Chapter 14 are in such an order and magnitude that they promote optimum growth. Progressing through the stages too quickly or in an altered order can lead to underutilization of the neuromuscular system, injury, improper recruitment patterns, decreased potential for strength and power, and even more undesirable results.

It should be up to a professional to decide which parts need to be focused on and which can be ignored or worked less.