Active Care Treatment Protocol For Low Back Pain

Spine Stretching Science

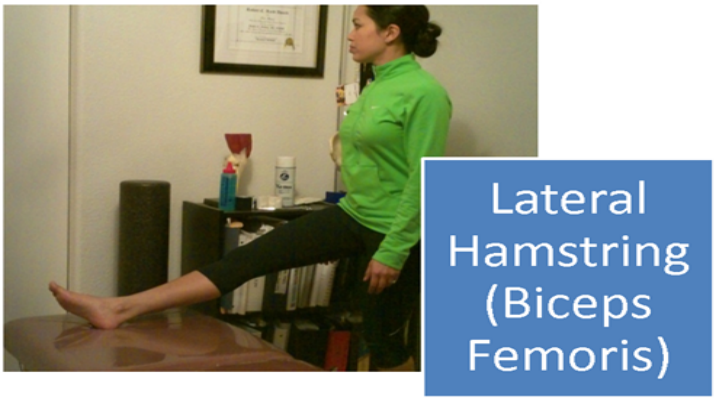
Most patients have one of two views on stretching. Either they liken a simple stretching routine to medieval torture, or they believe that it will cure any ailment. We know from McGill and Solomonow's work that stretching the back is generally not a good idea. The spine only has a certain number of flexion cycles available before ligamentous and annular damage occurs. Solomonow has showed us that stretching the spine actually dampens the stretch reflex, effectively reducing the capacity of the trunk musculature to actively stabilize the spine. His work has also demonstrated that prolonged ligamentous stretching actually creates muscle spasm in spinal stabilizers. We also know that gaining hip mobility allows the body to go through functional movement with less spinal motion, sparing the spine from cumulative trauma injury.

Spine neutral static stretching is an essential part of any low back rehabilitation program. Incorporating these stretches help both types of patients, the stretch weary and stretch eager. The patient who despises stretching is given a safe method to increase mobility to levels need to function. These patients are usually a little tight and may have some asymmetries from repetitive motions or prolonged postures. These restrictions often respond very quickly to simple stretching exercises.

The patient who is addicted to stretching is even more likely to benefit from a spine neutral stretching program. These patients are likely to stretch when they have pain, effectively reinforcing the spinal instability and muscle spasm that is probably the source of their pain in the first place. By teaching them to adhere to a spine neutral posture you will protect their body from further ligamentous damage that occurs at end range postures and give the spinal stabilizers a chance to function in a normal range of motion

STRETCH #1: 3 WAY HAMSTRING STRETCH

The 3 way hamstring stretch is an essential part of any stretching programs. When most people attempt to stretch their hamstrings, they bend over with a flexed lumbar spine to touch their toes. This becomes more of a spinal ligament stretch than a true hamstring stretch. By focusing on maintaining a spine neutral posture we can isolate the hamstrings and be more efficient with the stretch. An often overlooked component of hamstring stretching is the fact that there are 3 hamstrings with different attachments. We need to stretch in 3 planes to stretch all 3. This stretch allows us to engage the fascial planes of the entire hamstring group. The following 3 pictures demonstrated how to stretch the hamstring in all 3 planes. In short, the patient basically turns from rotates the torso from left to right (or left to right, depending on the leg being stretches) while bending the leg not on the table and keeping the spine straight. See pictures below :



PSOAS AND ILIACUS STRETCHES:

The psoas originates on the anterior aspect of the lumbar vertebrae and attaches to the lesser trochanter. The psoas is best stretched in the lunge position with a neutral to posterior pelvic tilt, trunk lateral flexion to the contralateral side, and ipsilateral trunk rotation. The ipsilateral rotation is accentuated in the picture above with arm motion.

To stretch the iliacus, which originates on the ilium, a sagittal lunge with a focus on neutral to posterior pelvic tilt is sufficient.

Psoas

Iliacus

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ADDUCTORS

The adductor group can be interesting to work with because of the strong fascial attachments and anatomic relationships between the adductors and their neighboring muscles. The adductor magnus acts functionally as a hamstring once the hip is flexed past 70 degrees. Adductor magnus strains are often misdiagnosed as hamstring strains due to their close proximity to the hamstring group and similar action of hip extension.

Many clinicians forget or neglect to accommodate for the fact that the gracilis is a two-joint adductor due to its attachment distal to the knee at the pes anserine. A good stretching program will include adductor stretches with the knee flexed and extended. This will ensure that both the short and long adductors are stretched appropriately.

Abductors

The gluteus medius is the primary abductor of the hip. In most instances, this muscle is actually lengthened and does not require stretching. Patients with wide hips, especially females, may require lifestyle education and neuromuscular retraining to avoid excessive adduction with gait and prolonged posture. Teaching patients with this issue to put a pillow between their legs when sleeping on their side and avoid crossing their legs while sitting is usually a good first step towards regaining proper abductor length.

GLUTEAL STRETCHES:

The Gluteus Maximus is the primary external rotator and extensor of the hip. Underneath the powerful gluteus maximus sit the “deep 6” hip rotators. These include the piriformis, superior and inferior gemelli, quadratus femoris, and obturator internus and externus. Many treatment techniques claim to isolate each of these small muscles. On most individuals, this is probably not prudent or possible due to the thickness of the overlying gluteus maximus. These muscles function as a group, not individual units, and can be treated as such.

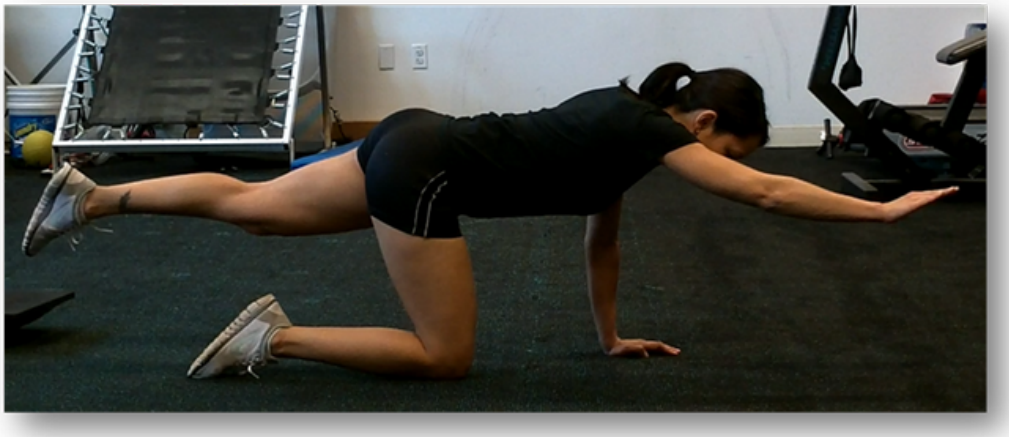
When stretching the external rotators remember that their action switches to internal rotation after 90 degrees of hip flexion.

Neuromuscular re education for lumbar spine:

Cat/Camel stretches (https://youtu.be/XbszYAh2834)

QUADRIPED LEG EXTENSION (https://youtu.be/Rjeu0oq4CxU)

BIRD DOG (2ND PIC IS IPSILATERAL BIRD DOG-MORE ADVANCED VERSION)
https://youtu.be/cqJF8qd57DE



https://youtu.be/8_-db1z4Cbs

DEAD BUG EXERCISE PROGRESSIONS (after abdominal bracing/hollowing):

Abdominal Bracing:

Abdominal bracing is a spinal stabilization technique in which full co-contraction of the abdominal wall (external oblique, internal oblique, transverse abdominis, rectus abdominis) is used to increase mechanical stability of the trunk. Proponents of abdominal bracing describe the abdominal wall as plywood, with multiple layers stacked in multiple directions creating a system of stability in which their combined strength is greater than the sum of their parts. Abdominal bracing has been shown to increase intra-abdominal pressure through the hoops stresses of the abdominal musculature, forming “nature’s back belt.” Bracing has been quantitatively proven to be an effective technique in stiffening the lumbar spine, even during external perturbation (Veragarcia).

Several techniques have been described to teach abdominal bracing. Verbal cues, such as “tighten your abs” or “tighten your abs and your back” are often combined with palpation of the abdominal wall for assessment of full contraction (Liebenson). Often patients will try to hold their breath while bracing. In these cases, special attention will be made to incorporate normal breathing patterns with the abdominal bracing maneuver. An abdominal brace does not need to be held at full contraction in order to maintain spinal stability, in fact only 20-20% of maximal voluntary contraction is necessary. (McGill)

https://www.youtube.com/watch?v=J_2ImNPjxtc

https://www.youtube.com/watch?v=MsnjPgSpxUg

Dead Bug With Upper/Lower Extremity Movement

Begin with the patient supine in the hook lying position and arms in flexion. Instruct the patient to lightly brace, and then extend one arm to 90 degrees. Watch for trunk motion, cervical spine flexion, or pelvic motion during arm flexion. If faults are present, correct them before advancing to lower extremity motion.

https://youtu.be/ZW7b6AU0oWc (Upper extremity)

https://youtu.be/A3vjBvzxk54 (Lower extremity)

Once the patient can perfectly perform 5 repetitions of both upper extremity and lower extremity variations of the exercise, they are ready to proceed to diagonals of coordinated contralateral upper extremity extension with lower extremity flexion.

Dead Bug with Short Lever Contralaterals

https://youtu.be/QPIe7lZo5qE

Next Progression:
https://youtu.be/S88K-856ULg

Dead Bug Contralaterals - Long Lever Arm

https://youtu.be/0NqjF2oqRt8

Dead Bug Foam Roll Intermediate:

https://youtu.be/B8POAm9Uhv4

HIP HINGE WITH BRACING

Teaching the hip hinge is as simple as having the patient lean forward by “sticking your bottom out and keeping your chest up.” If the patient has difficulty disassociating spinal motion from hip motion, ask them to place both hands at the crease of the hips to reinforce the hip as the prime mover. One of the best ways to reinforce hinging the hips as an everyday movement pattern is to have the patient stand from a chair without any

coaching. Have the patient analyze their natural movement pattern and compare this to the hip hinge. Then teach them how to properly rise from a chair. Some helpful cues are to externally rotate the feet to activate the glutes, brace the core around a neutral spine, and lead with the chest. This is actually a hip hinge in reverse. Reverse patterning is a motor learning teaching trick that can be very effective for the patients with poor neuromuscular control.

HIP HINGE VIDEOS:

https://youtu.be/PkGvb4lUhHs

https://youtu.be/78AEHwdIQTY

https://youtu.be/23oqeoTxURs

HIP HINGE SHORTSTOP SQUAT

Many athletes naturally hip hinge without realizing it. The universal athletic position is in fact a static hip hinge. Stu McGill calls this motion the “Shortstop Squat.” This exercise can be used as a simple warm up before rehab exercise to reinforce the importance of a spine neutral starting position in athletic endeavors.

https://youtu.be/mrZZjZ3AbtI

SWISS BALL SQUAT

The swiss ball squat is a safe way to transition an individual who is very weak, overweight, postsurgical, or uncoordinated into exercise based on the hip hinge. Placing a swiss (physio) ball behind the patient takes away body weight and creates a partial weight bearing exercise in an upright posture. The importance of exercising in upright posture cannot be understated. Inter and intramuscular firing patterns are dependent on the posture the body is trained in, so we must exercise in upright weight bearing positions in order to guarantee the adaptation transfers to daily activities.

The percentage of weight bearing can be controlled in the swiss ball squat by modifying foot position. The more anterior the feet, the greater percentage of body weight is absorbed by the ball. Begin with the ball in the curve of the low back and the feet slightly in front of the body. Teach the squat as a full range of motion hip hinge. First brace the core and turn the feet out slightly, then lift the chest and reach back with the buttock. Allow the patient to squat as low as they are capable without hinging at the lumbar spine. As they master this squat, move the feet close to the body to increase weight bearing. When a patient shows they can complete 3 consecutive sets of 15 squats they are probably ready to advance to box squatting or even body weight squats.

SWISS BALL SQUAT VIDEO:

https://youtu.be/B7pjt3c8QDc

SNATCH PULL

The snatch pull is an exercise taught by weightlifting coaches to develop power from the hips and build a strong, stable lumbar spine. In Olympic style weightlifting the hips are used to develop extreme amounts of power through the barbell and transfer that power to the shoulders to complete a full overhead lift. The spine is used to transfer that power from the hips to the shoulders. Intersegmental motion of the spine leaks kinetic energy from this system and diminishes potential performance.

In the clinical setting, pull exercises are used to first develop solid foundational movement patterns and later to strengthen and develop power from the hip hinge position. A dowel is used to teach the pattern with minimal load. External load can be added as competency is developed.

Have the patient stand upright holding the dowel with a closed grip. If the dowel is grasped at shoulder width, this is a “clean” pull. A wider grip is a snatch pull. This widened grip can be beneficial in patients with scapulothoracic dysfunction, as it is an ideal position to train scapular depression. Begin the motion with an abdominal brace, and ask the patient to slowly lower the dowel to the knees with an elevated chest. This is a reverse patterned hip hinge. Once the dowel is at the knee position, have the patient hold the position and recheck their posture. The shoulders, knees, and feet should be in a perfect vertical line in relationship to each other. From here, have the patient rise with a neutral spine to the starting position. This is the “pull”. Power and strength can be emphasized by increasing speed of movement and resistance, respectively. It is important to emphasize the return to standing as a vertical motion. Some individuals will attempt to extend at the lumbar spine, finishing with the shoulders posterior to the hips. This is a dangerous position for the PARS and interspinous ligaments, especially with additional load. Many weightlifters have developed posterior arch fractures from finishing lifts in the extended position rather than finishing straight vertical.

SNATCH PULL VIDEO:

https://youtu.be/MXAOYfVGKIM

DEADLIFT

The deadlift pattern has been deemed a low back killer by many health care professionals. A poorly executed deadlift can be dangerous, especially if performed repeatedly or with extreme load. However, the deadlift is a motion that occurs repeatedly in life. If we cannot deadlift, how will we pick anything up off the floor?

Teaching the deadlift require patience and creativity. Never advance to a position that compromises the lumbar spine. Focus on correcting mobility restrictions prior to exercising the deadlifting pattern. Always begin with abdominal bracing and hip hinging as the base for the deadlift.

A deadlift is performed any time a still object is picked up off the ground. The traditional example is the barbell deadlift, as performed in weight training and powerlifting. In the rehabilitation setting we seldom begin with a barbell deadlift. Most patients will never and have never touched a barbell in their lives. However, they will need to pick things up off the ground. This is why we teach many versions of the deadlift.

Begin the deadlift with the hands placed on the object to be lifted, the chest in an upright position. The elbows and knees should be in the same coronal plane. Before

initiating motion, brace the core and set the spine in a neutral position. The lift begins with an abdominal brace and is followed by extension of the hips from the glutes and hamstrings. Keep the object as close to the body as possible. This minimizes anterior shear at the lumbar spine. Once the object has reached the level of the knee, the motion is identical to the Pull exercise. **The lift** should be finished in the vertical upright position. The commonly seen hyperextension at the end of the deadlift is a remnant of competitive powerlifting in which the competitor had to prove completion of a full upright posture and thus exaggerated to demonstrate completion. Again, this is a dangerous position that should be discouraged.

If a patient does not have adequate mobility to reach a deadlifting start position, begin the lift with the implement placed on a box, or begin with a taller object. Lifting blocks be required to train tall athletes whose anatomical limitations make deadlifting with a traditional barbell impossible. Kettlebells are a preferred implement for tall individuals or non-athletes because of the height of the handle and similarity in shape to everyday objects (boxes, etc).

DEADLIFT VIDEO:

https://youtu.be/Ce7fQGh-jfY

SINGLE LEG DEADLIFT

The single leg Romanian Dead lift (1 leg RDL) is a very versatile exercise that trains the deadlifting pattern in single leg stance. This exercise incorporates spinal stability, hip extension strength, coronal plane hip stability, and eccentric hamstring load. Virtually every knee, hip or back patient can see some benefit from mastering the 1 leg RDL.

In daily life, the 1 leg RDL is used as a strategy to pick up light objects that are placed very low to the ground with a neutral lumbar spine. If mobility restrictions do not allow an object to be lifted with the traditional two legged deadlift, the single leg deadlift can be used instead.

To teach the 1 leg RDL, have the patient flex forwards at the hip and reach forward with the both hands. Reaching forward reinforces the spine neutral posture. As the free leg is lifted, keep it in the same plane as the spine. This creates a contralateral pattern of hip flexion and extension, a complex neuromuscular task. As competency increases, increase difficulty with external resistance.

The 1 Leg RDL can be performed with external load held in the **ipsilateral hand, or contralateral hand**. Contralateral resistance increases the coronal stability required to complete the lift. Kettlebells are ideal implements for this exercise due the height of the handle and stability of having one base of mass.

SINGLE LEG DEADLIFT VIDEO:

https://youtu.be/D1gAs8CzCtc

THE SQUAT

The front squat, back squat and single leg squat are the most commonly used squat variations. In low back pain patients, the single leg squat is probably the best initial choice due to the low resistance used, thus decreasing compressive load on the spine. The front squat is performed with about 80% of the load of the back squat, and would be the next choice in the progression of resisted squatting. Back squatting can be performed with very heavy external load and should be saved for individuals with a high functional capacity.

The initiation of the squat should begin with abdominal bracing on a neutral spine, an isometric external rotation of the lower extremity to enhance gluteal activity, and then production of movement via the hip hinge. The cues of **"chest up and butt out"** are especially valuable while squatting with load. Some patients will initiate the squat at the knee by pushing both knees forward. This is a quadriceps dominant strategy that may increase load on the anterior knee and reduce performance by biasing muscle activity

away from the powerful hip extensors of the posterior chain. These patients will benefit from a cue to sit back as if they were sitting on a chair, and then rise leading with the chest.

The **single leg squat** can be performed with the free leg in numerous positions. The position that is probably most commonly used is a single leg squat with the free leg held in front of the body. This requires good hamstring and posterior chain flexibility and hip flexor isometric strength. Patients with mobility restrictions may flex at the lumbar spine to make up for the lack of mobility. If this occurs, squatting with the leg reaching posterior should be utilized until mobility deficits are treated.

Squat depth is a controversial topic among both coaches and health care providers. With the low back patient, the main concern is with increased depth posterior pelvic tilt at the bottom of the squat. If you notice a patient' pelvis tucks into posterior tilt and creates lumbar flexion at low squat depths, try to teach them the appropriate pattern and do not let them squat to that depth until the problem is corrected.

THE SQUAT (BACK, FRONT,SINGLE LEG AND JUMP SQUAT) VIDEO LINKS:

https://youtu.be/vl-iHraaBEA

https://youtu.be/6TZyEZL2HQ8

https://youtu.be/93VnPTZiJM4

https://youtu.be/p903c0RZ23s

KETTLEBELL SWINGS

The kettlebell swing is an interesting exercise because it nearly perfectly mimics the hip action of a maximal jump with added resistance and no impact to the spine. By focusing on quickly hiking the kettlebell through the legs, an explosive change from eccentric to concentric contraction of the hip extensors can be trained. A properly performed kettlebell swing is finished with a vertical position of the hips and torso. This position requires a full contraction of the glute max and reinforces neutral pelvic posture in athletes who are prone to anterior pelvic tilt.

KETTLEBELL SWING VIDEO:
https://youtu.be/UUBRuEGPM4Q

The Plank

The plank position allows for co-contraction of the abdominal wall, with an emphasis on the anterior abdominals. Similar to the quadruped, the plank allows gravity to push the visceral contents into the abdominal musculature, facilitating muscle activation. Modifications can be made to the plank exercise to match difficulty to the patient's work capacity.

The beginner plank is performed with a base of support consisting of the elbows and knees. The spine should be in a neutral posture with the chin retracted. The scapulae should be held firmly against the thorax, retracted and depressed. A light abdominal brace should be held for the duration of the plank hold. If the patient cannot maintain ideal posture, a light abdominal brace, or normal respiration, the hold should be stopped and a rest interval allowed. Usually, 5 to 10s holds are ideal for beginners to learn the plank position. Hold times can be increased as work capacity increases.

https://youtu.be/PdK6KHyZMIg

Plank with Extremity Motion

If perfect spinal posture cannot be maintained, the patient is not ready for the modifier. Appropriate difficulty is reached when the exercise is very difficult to perform, but can be performed correctly. Once the exercise has been mastered a more difficult version should be introduced to maximize the adaptation response.

The intermediate plank is performed with weight bearing on elbows and toes. The teaching cues for the intermediate plank are the same as those for the beginner plank. An interesting fact about the plank is that it achieves more rectus abdominis contraction than the sit up exercise. This is important for back pain patients to understand, especially if they are emotionally attached to sit up variations for "core training."

https://youtu.be/nf_fevqgsJc

Modifiers to increase difficulty from the plank position include lifting of one or more extremities, advancing to a hand and toes (push up) position, using unstable surfaces, and incorporating motion such as rolls into the side plank position or roll outs with a bar, ball or wheel. If perfect spinal posture cannot be maintained, the patient is not ready for the modifier. Appropriate difficulty is reached when the exercise is very difficult to

perform, but can be performed correctly. Once the exercise has been mastered a more difficult version should be introduced to maximize the adaptation response.

The physio ball roll-out for sagittal stability and advanced anterior core training. The stir the pot exercise is extremely challenging due to the multiplanar stability required.

Shoulder taps from the full plank (push up) position incorporate longer levers to challenge rotary stability.

https://youtu.be/hN4-KqHuqwo

Contralateral upper and lower extremity motion creates a small base of support to challenge trunk stabilization.

https://youtu.be/hN4-KqHuqwo

The wobble board as a tool to challenge rotary stability.

https://youtu.be/w5bmteIfFuQ

END OF PLANK PROGRESSIONS

The Side Bridge

The Side Bridge position creates a challenge for the entire abdominal wall. In particular, the oblique abdominals recuts abdominis, and back extensors are heavily recruited to stabilize in the side bridge position. The chart below details EMG activity of trunk stabilizers measured during variations of the side bridge. The researchers noticed very high activity of all trunk stabilizers when rolling from the side bridge to the plank position.

The introductory level side bridge begins with the patient side lying on their elbows and knees. The hips are slightly flexed. The patient then braced the abdominals and lifts the hips into an extended position. This will lift the lateral abdomen of the down side off the ground. The spine should be in a neutral position, with the head in line with the spine.

https://youtu.be/7OSScs-hwX8

The full side bridge is performed with the legs extended and the feet staggered with the top foot slightly in front of the bottom. The head should be in line with the spine. Difficulty can be increased by stacking the feet or using the arm to resist an isometric rotation push of the torso.

https://youtu.be/gQ9QUF0uHqI

Extremity motion can be utilized to increase difficulty and simulate trunk stabilization tasks that occur in daily life or sport. For example, hip flexion form the side plank position may be appropriate for a running athlete. The lateral hip stability used in this position can be used for patients with valgus collapse at the knee during motor tasks. Performing side lying hip abduction with the top leg during a side bridge simultaneously introduces an isometric and dynamic coronal plane hip stabilization component to the exercise.

Side bridge with hip motion:

https://youtu.be/qYXY-MmN3Uk

Rolling from the side bridge to plank position should only be performed if a spine neutral posture can be maintained throughout the roll. This can be practiced while leaning against a wall and progressively moved to the floor.

Side bridge with rotation:

https://youtu.be/V85xO4Rkv4A

END OF BRIDGE EXERCISES

Gluteal Isolation Exercise:

For gluteus **medius** activation, 5 exercises are “top tier,” meaning they have greater than the 50% maximum voluntary contraction that has been shown to be needed to strengthen a muscle.

Continued on next page:

1. Side lying hip abduction – this had 16% greater activation of the gluteus medius than any other exercise
2. Single leg squat
3. Lateral band walk (link below)

https://youtu.be/b8Y4X2wg__4

4. Single leg deadlift
5. Sideways hop

For the gluteus maximus, only 2 exercises can be categorized as “top tier”: (for links, see earlier sections):

1. Single leg squat
2. Single leg deadlift

Non-weight bearing exercise may be required for patients with **severe and/or acute low back pain**. The glute bridge uses a flexed knee position to limit the mechanical advantage of the hamstrings in hip extension. The patient should begin supine in the hook lying position. From this position the patient should be instructed to brace the abdomen, squeeze the glutes together, and lift the hips off the ground. The patient should strive to reach full hip extension. Hip flexor shortness/hypertonicity may limit the range of this motion, and may need to be addressed. Prescribing this exercise immediately after manual therapy or stretching of the hip flexors will help the patient learn to use their newly attained mobility.

2 Foot Gluteal Bridge:

https://youtu.be/BvpJdhc3CT0

The band assisted squat, or “prisoner squat” uses elastic resistance to help the body move with proper lower extremity movement. Gray Cook calls this Reactive Neuromuscular Training. Individuals who squat with hip adduction will benefit from the gluteal activation that occurs during the prisoner squat. In patients who go into valgus collapse due to pronation at the foot, placing the band around the ankles can be palliative.

Band assisted/Prisoner Squat:

https://youtu.be/qighcP01mew

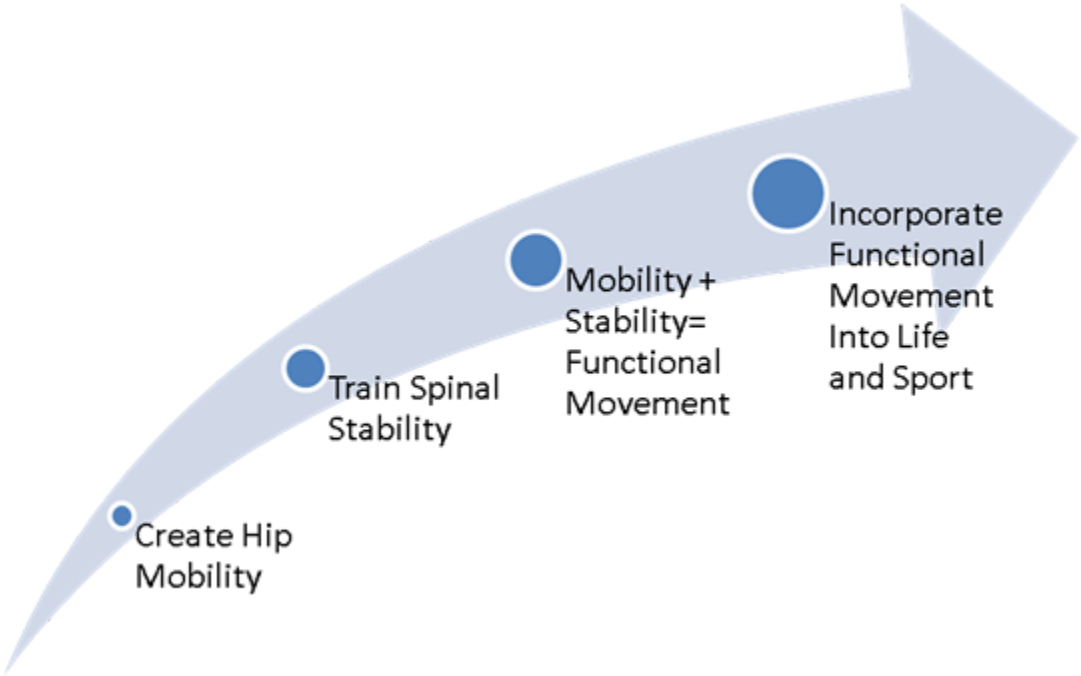
Rehabilitation Program Design

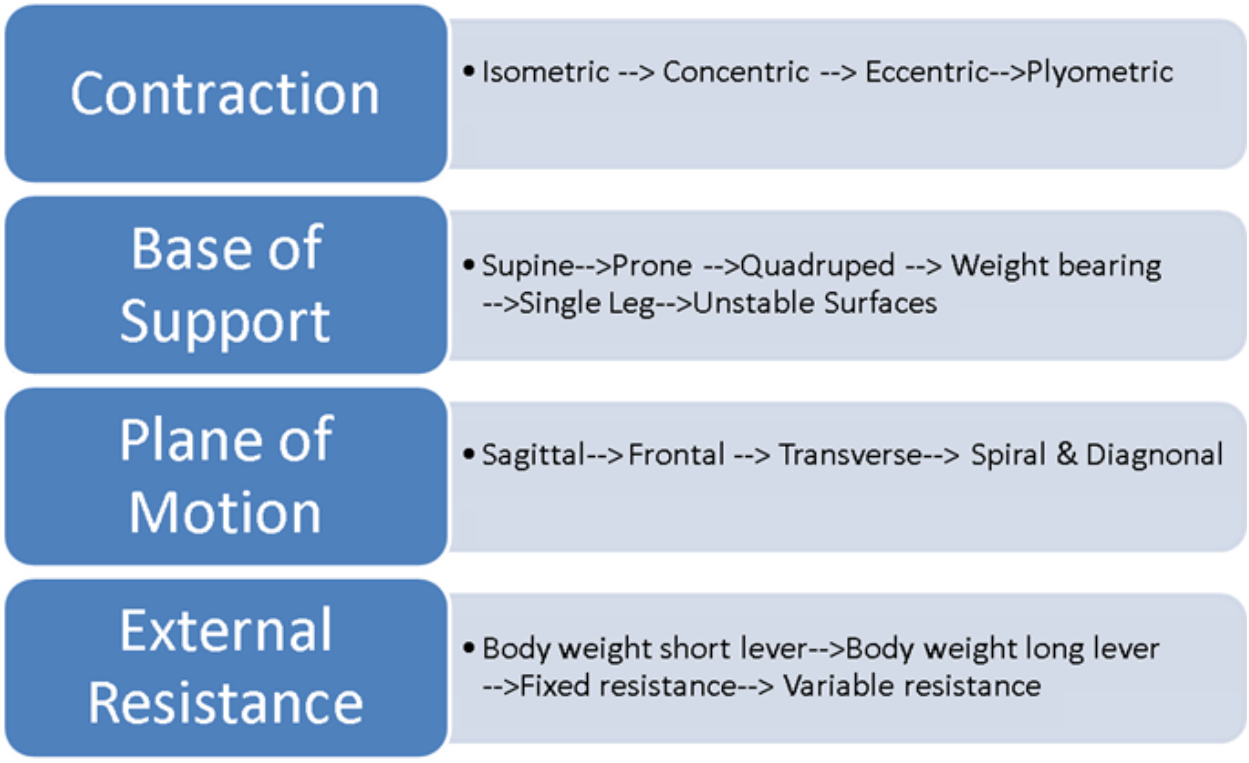
Rehabilitation Program Design: A Recipe for Success

The Activity Intolerance Model

I once heard a famous strength and conditioning coach tell a class that when designing an exercise program: “If you’re not a chef, don’t change the recipe.” What he means by this is that the safest, most effective route to success is to do what has been proven to work. I think this is a good concept in rehabilitation program design.

Low back rehabilitation progression model:.





Frequency

Frequency of rehabilitation will depend on the patient's occupation, lifestyle, and goals. While Olympic caliber athletes will often rehabilitate an injury for 3 hours a day or more, the average patient may only spend a half hour a week with therapeutic exercise. Determining the optimal frequency can be difficult. Here are some things to consider when programming rehabilitation frequency:

- If something is important, you must do it every day.
- There is a low return on investment to exercising more than 3-4 days a week.
- There is a low return on investment of plyometric exercise being used more than 2 days a week.
- In elite athletes, less than a 1% difference in performance can be the difference between winning and qualifying to compete.
- In elite athletes, it takes a ten-fold increase in volume or intensity to get a 1% increase in performance.

In rehabilitation exercise, we typically are not concerned with the performance variables listed above. Instead, we monitor quality of technique. On a scale of 0 to 10, in which

at 0 the exercise could not be performed and 10 is flawless execution, any exercise performed at an 8 or below should be stopped and modified. The two caveats to this guideline are that the patient may continue if they show improvement with each repetition, and there are times when it may be pertinent to let a patient struggle with technique to finish out an exercise with an endurance goal if there is not an increased risk of injury by doing so.