

An overview of facilitated stretching

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This article offers a brief look at facilitated stretching, an active-assisted form of stretching based on proprioceptive neuromuscular facilitation. It describes the method, the rationale for its development and use, and gives detailed instructions for performing several stretches, both with a facilitator and alone. © 2002 Harcourt Publishers Ltd

Introduction

Flexibility and coordination make it easier to accomplish any task that requires the use of muscles. They are major components of optimum athletic performance and also play an important role in our daily lives. Flexibility and coordination are critical to preventing injuries, whether on the playing field, in the warehouse, or in front of the computer. Overuse injuries, or repetitive stress injuries, occur in part because of soft tissue restrictions that limit flexibility (Cash 1996, Benjamin & Lamp 1996).

Over the past 20 years, proprioceptive neuromuscular facilitation (PNF) stretching has gained popularity, especially in the athletic and therapeutic community and increasingly with the general public. PNF stretching uses an isometric contraction prior to the stretch to achieve greater gains than are typically achieved from static stretching alone. PNF stretching is generally done passively; that is, a facilitator administers the stretch to the stretcher.

Facilitated stretching is based on PNF principles and techniques but is an *active* form of stretching, in which the stretcher does most or all of the work. When a facilitator is involved, the facilitator's job is to monitor and direct the stretcher's activity. Facilitated stretching is also known as CRAC stretching, an acronym for contract-relax, agonist-contract (The muscle that moves the body segment in the desired direction is the agonist, the muscle being stretched is the antagonist).

Facilitated stretching sequence: simplified version

Facilitated stretching is active-assisted stretching, which uses active motion and isometric work to improve flexibility and enhance motor learning in the process. Simplified, the steps involved in facilitated stretching are:


1. Actively lengthen the target muscle to its end-range,
2. Isometrically contract the target muscle, and

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3. Actively lengthen the target muscle again to a new end of range motion.

Rationale for use

The developers of PNF therapy based some of their work on activating several physiological mechanisms in the body (Voss et al. 1985). For facilitated stretching, interest lies in two of them: reciprocal innervation and the inverse stretch reflex. Research into whether these mechanisms are actually responsible for the effects attributed to them in PNF has produced mixed results (Sapega et al. 1981, Taylor et al. 1990, Moore & Hutton 1980, Condon & Hutton 1987, Cornelius 1983, Osternig et al. 1987, 1990).

Reciprocal innervation (reciprocal inhibition) is a reflex loop between opposing muscles (Alter 1996, Adler et al. 1993). When one muscle contracts, reciprocal innervation simultaneously inhibits the opposing muscle on the other side of the joint. This allows movement to occur around the joint. For instance, when the quadriceps muscle contracts, the hamstring is reciprocally inhibited, thereby allowing the knee to straighten.

In facilitated stretching, the stretcher uses active motion to stimulate the reciprocal innervation response, thereby maximizing the lengthening of the target muscle.

The inverse stretch reflex (also called autogenic inhibition) causes a muscle under tension, either from a strong stretch or a strong contraction, to suddenly give way. This reflex was originally thought to be mediated by the Golgi tendon organs (GTOs), which are located in the musculotendinous junction and the tendon. The developers of PNF used maximal isometric contractions based on their belief that doing so would stimulate the GTOs to fire the

inverse stretch reflex. Alter summarizes a plethora of subsequent research on the neurophysiology of PNF. Regarding autogenic inhibition, he says, 'It [autogenic inhibition] is now believed to be the result of afferent input from Group II nerve fibers coming from the muscle spindles and perhaps from thinly myelinated fibers subserving pain sensation from the joints' (Alter 1996).

It is known that one of the functions of the GTOs is to monitor the load on the tendon. GTOs are more sensitive to tendon loading from muscular contraction than from passive stretch, they have a low stimulation threshold and have a *dynamic sensitivity* that allows them to report small changes in muscle contractile forces (Alter 1996). These factors may help explain the phenomenon of *post isometric relaxation* (PIR).

Post isometric relaxation

PIR is another way of describing what results from an isometric contraction. Chaitow, in his text on muscle energy techniques, describes PIR as follows: 'Following on from an isometric contraction . . . there is a refractory, or latency, period of approximately 15 seconds during which there can be an easier (due to reduced tone) movement towards the new position (new resistance barrier) of a joint or muscle' (Chaitow 1996). In muscle energy work, the patient may be asked to use as little as 10% of his maximum strength during the isometric contraction, yet the relaxation effect is still achieved.

So, although the developers of PNF based their work on stimulating the inverse stretch reflex through a maximal contraction of the target muscles, the results obtained in facilitated stretching, which uses less than maximal effort in the isometric phase, may be the

result of PIR, or some other mechanism, or combination of effects not yet understood. Further research in this area would shed welcome light.

Lewit and PIR technique

Besides being the name of the physiological result of an isometric contraction, PIR is also the name given to a technique introduced by Karel Lewit for the treatment of myofascial pain. The protocol is similar to facilitated stretching, but the goal of Lewit's PIR technique is normalizing the tone of hypertonic muscles, not stretching. In Lewit's technique, the hypertonic muscle is passively lengthened to its resistance barrier, then isometrically contracted, using only 10–20% of its strength, for 5–10 seconds. After the contraction, the patient completely relaxes and the practitioner moves the limb to the new resistance barrier, taking up any slack now available, but not stretching the muscle tissue. This process is repeated several times (Lewit & Simons 1984, Chaitow 1996).

Facilitated stretching sequence: detailed version

(Editor's note : the descriptions in the remainder of the article are written in instructional style in which second and third person narrative is used)

As mentioned earlier, facilitated stretching is frequently done with a facilitator, although many of the stretches can be done alone, assisted by accessories. The detailed steps involved in a facilitator-assisted facilitated stretch are as follows:

1. The stretcher actively lengthens the muscle to be stretched (the target muscle) to its maximal pain-free end range. This is also called the soft tissue barrier or restriction barrier (Chaitow

1996). This active movement incorporates reciprocal inhibition.

For example, if you wish to stretch the hamstring, have the stretcher lie on his back and contract his quadriceps and psoas (hip flexors) to actively lift the leg as high as possible, keeping the knee straight. You may need to hold the knee straight as the stretcher lifts his leg. This stretches the hamstrings to their end range. As the hip flexors contract to lift the leg, the hamstrings are reciprocally inhibited.

2. As the facilitator, you then position yourself to offer resistance for the stretcher to isometrically contract the target muscle against. For stretching the hamstring, support the lower leg against your shoulder or by holding it with both hands (Fig. 1).
3. Direct the stretcher to begin *slowly* and ‘push’ or ‘pull’ to isometrically contract the target muscle as you provide matching resistance. You want the stretcher to work, but not with so much effort that he overpowers you. When the stretcher has achieved the proper level of isometric contraction, hold it for 6 to 10 seconds. The stretcher breathes normally throughout. This isometric contraction causes post isometric relaxation.
4. The stretcher then relaxes the isometric contraction and inhales deeply. During this time, maintain the limb in the starting position.
5. On the exhale, the stretcher contracts the opposing muscle—in this case the quads and psoas and pulls the target muscle into a deeper stretch, once again using reciprocal inhibition to enhance the stretch. As the facilitator, don’t push or pull to deepen the stretch (Fig. 2). (Facilitated stretching is an active technique whenever possible. If the facilitator aids in the stretch, it becomes a passive stretch, and the stretcher loses the opportunity to improve his muscular coordination and activation through active movement. There is also the added risk of injury inherent when a facilitator is passively moving the limb to a new end of range motion.)
6. Now the facilitator moves into the new position to once again offer resistance.
7. Repeat the process two to three times.

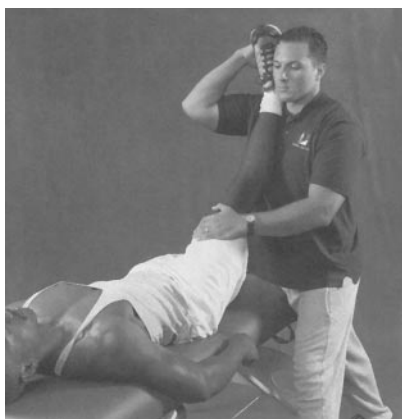


Fig. 1 Starting position of the hamstrings stretch (right leg). Support the stretcher’s leg using excellent biomechanics.

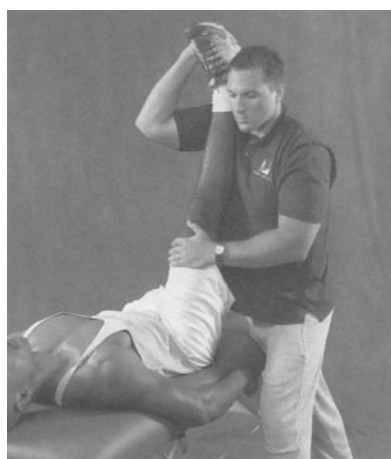


Fig. 2 The stretcher actively deepens the stretch.

Facilitated stretches should always be pain free. If the stretcher experiences pain or discomfort, try repositioning the limb or use less force during the isometric contraction of the target muscle. If pain persists, don’t stretch that particular muscle until you’ve determined why it’s causing pain.

You can use this sequence to construct a stretch for any muscle you would like to stretch that can contract isometrically.

Use of language

In general, your instruction to the stretcher will be to either ‘push’ or ‘pull’ during the isometric phase. This communicates more clearly what you wish to have happen. If you ask the stretcher to ‘resist’, you are communicating that you will be doing something to her that she needs to act against. In fact, you want her to contract the muscle, the force of which you, as the facilitator, will resist. This also helps to encourage the stretcher to take an active, rather than passive, role in the process.

Breathing

Muscles need oxygen to work. Even so, many of us are in the habit of holding our breath during strong muscular effort. During facilitated stretching, it’s important to breathe, especially because we are not asking for maximal effort on the part of the stretcher during any part of the sequence. Another reason for normal breathing is that holding the breath during the isometric phase is often accompanied by compensatory recruitment of other muscles. And third, there is some risk that holding the breath during muscular contraction may raise the blood pressure due to the Valsalva maneuver (Cornelius 1983, Cornelius et al. 1995).

It is easy to monitor the stretcher’s breathing (and your own)

throughout the process. Two cycles of normal breathing (in and out) takes about 10 seconds, which is about the length of time we want for the isometric contraction.

Safety issues

Stretching safely is of utmost concern for both the stretcher and the facilitator. Body mechanics are extremely important during all phases of stretching, but especially during the isometric phase. Plan carefully and communicate freely with each other. The facilitator providing the resistance may be expending unnecessary energy (because of poor ergonomics), or the stretcher may be working too hard. Not only can you become acutely injured by using these techniques carelessly, but you can develop overuse syndromes unnecessarily.

As with any flexibility training program, facilitated stretching should only be undertaken after carefully considering whether any contraindications to stretching are present. These would include, but are not limited to, recent injury accompanied by swelling and/or inflammation, recent surgery to the area to be stretched, joint hypermobility that would be aggravated by stretching, and pain during any phase of the stretch.

Importance of positioning

To achieve the most benefit from stretching, our goal is to position the stretcher to isolate the target muscle as much as possible. This isolation ensures that the target muscle is the primary one contracting during the isometric phase and being stretched during the lengthening phase. Although it is impossible to completely isolate and activate only one muscle, careless positioning allows inappropriate, compensatory muscle recruitment and interferes

with achieving optimum results from facilitated stretching.

For instance, when doing a hamstrings stretch, it is common for the stretcher to lift the ipsilateral hip off the table during the isometric contraction of the hamstrings. This unconscious shift engages the gluteus maximus more usually because the hamstrings are weak. Directing the stretcher to keep the hip in contact with the treatment table will ensure that the hamstrings are more fully engaged during the isometric phase and more able to stretch in the lengthening phase.

Reducing fatigue

Because facilitated stretching is an active form of work, it can be fatiguing for both the stretcher and the facilitator. Reducing fatigue can reduce the chance of injury.

For the stretcher, it is important to remember that maximal effort is not necessary. We need only a moderate contraction of the target muscle during the isometric phase. This can be especially important for stretchers who don't participate in a regular exercise program because they may experience delayed onset muscle soreness the day after a stretching session if they work too hard.

For you, the facilitator, reducing fatigue becomes an issue if you are working with several people throughout the day. Injuries are more likely if you are fatigued. One of the benefits of facilitated stretching is that the stretcher does most of the work. As the facilitator, your main task is to assist the stretcher, not do the work for him. The stretcher moves the limb into position; you don't have to lift it or support it for him except for brief periods during the sequence. Relax whenever possible during the session and expend only the effort necessary.

If you are using good body mechanics, you will usually have a mechanical advantage when resisting the isometric contraction of the stretcher. This leverage allows you to accomplish your work with minimal physical effort.

Passive stretching

When using facilitated stretching, we normally ask the stretcher to actively stretch the target muscle by contracting the opposing muscle. In certain muscles, it is more productive and safer to stretch the target muscle passively. For instance, due to active insufficiency (Lowe 1996) and the fleshy mass of the calf, the hamstrings are usually unable to contract fully enough to adequately stretch the quadriceps. When the hamstrings are fully shortened actively, further attempts to contract the muscles usually lead to painful cramping. In this situation, the protocol is modified so the facilitator passively stretches the quadriceps by flexing the knee. Similarly, in some stretchers, the pectoralis major is so hypertrophied that active horizontal adduction of the humerus is limited. This limitation prevents the active lengthening of the rhomboids and middle trapezius, so passive stretching of these muscles becomes necessary.

Single plane facilitated stretches

Here are a few examples of single plane stretches:

Iliopsoas stretch-prone, with a facilitator

This stretch is used to improve hip extension.

1. The stretcher lies prone. If the stretcher has any low back discomfort in this position, place

a pillow under his hips to take some of the stress off the low back. Or you may want the stretcher to contract his abdominal muscles to stabilize and flatten his low back to eliminate low back discomfort.

2. The stretcher uses his hip extensors (gluteals and hamstrings) to lift his leg off the table as high as possible, with the knee bent. This lengthens the iliopsoas to its end of range. The stretcher must keep his hips flat on the table (or on the pillow) throughout this stretch. There will be a strong tendency for him to lift his hip as he lifts his leg. You may need to work with the stretcher on body awareness until he is able to stabilize his hips properly before performing this stretch.
3. Support the leg just above the knee to provide resistance to the isometric contraction of the iliopsoas. Use your hand or your leg to support the stretcher (Fig. 3).
4. Direct the stretcher to begin slowly to try to pull his thigh



Fig. 3 Initiation of the left iliopsoas stretch. Be sure the stretcher relaxes his gluteals when isometrically contracting the iliopsoas.

toward the table, isometrically contracting the iliopsoas. He is not trying to straighten his lower leg. During the isometric contraction of the psoas, make sure the gluteal muscles relax. It is very common for the stretcher to keep the gluteal muscles contracted while simultaneously trying to engage the psoas.

5. After the isometric push, the stretcher relaxes and inhales deeply. During this time, maintain the leg in the starting position.
6. On the exhale, the stretcher contracts the hip extensors to lift his thigh higher, deepening the psoas stretch. Be sure the stretcher keeps his hips flat on the table. (This helps prevent hyperextension in the lumbar spine and enhances the stretching of the iliopsoas. You can also direct the stretcher to perform and hold a pelvic tilt, using the abdominal muscles, to maintain the lumbar in a neutral position. Whenever possible, have the stretcher self-stabilize, rather than you doing it for him passively. In this way, the stretcher can carryover into daily activities what he learns on the treatment table.)
7. Repeat two to three times.
8. If you use your leg to provide resistance, move it closer to the hip with each round of stretching (Fig. 4).

Iliopsoas self-stretch

Because the stretcher is weight-bearing, this standing stretch incorporates passive movement to make it less awkward to stretch the iliopsoas.

1. Stand in a lunge position, with your left leg forward and right leg back, keeping your torso upright and your low back flat (Fig. 5).



Fig. 4 You may use your leg to provide resistance to the stretcher's isometric contraction, as long as it doesn't cause the stretcher's ASIS to lift off the table.

2. Keeping your right foot flat on the floor, push forward with your right hip to lengthen the right iliopsoas. Allow your left knee to bend as you push forward. You should feel the stretch high on the front of the right thigh.
3. Isometrically contract the right iliopsoas by attempting to pull your right leg forward but keeping the foot anchored on the floor. Be sure your gluteal muscles are relaxed! Maintain the isometric contraction for 6 to 10 seconds, then relax.
4. You can now stretch the iliopsoas by pushing the right hip forward again, being sure to maintain an upright posture with your low back flat.

Pectoralis major stretch-prone, with a facilitator

Stretching the pectoralis major can improve range of motion in horizontal abduction, flexion, extension, and external rotation of the humerus, depending on which

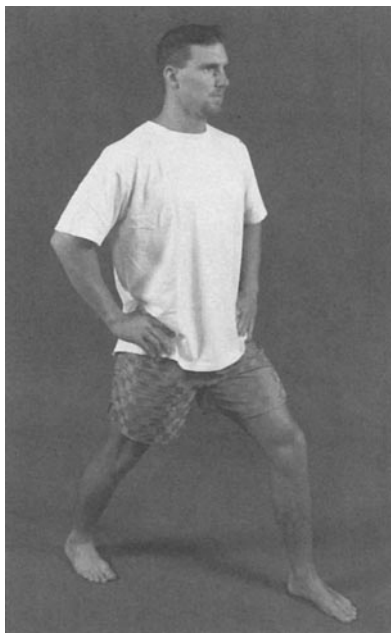


Fig. 5 Iliopsoas self-stretch (right leg). Keep your low back flat and focus on feeling the stretch high on the front of your right thigh.

fibers of the muscle are emphasized during the stretch.

1. The stretcher is prone, with his face resting in the face cradle, or his head turned to one side if no face cradle is available. His right arm is abducted to 90 degrees and externally rotated, with the elbow bent to 90 degrees. His upper arm rests on the table. Stand at the right side of the table and ask the stretcher to lift his right arm toward the ceiling (horizontal abduction of the humerus) as high as possible, keeping the forearm horizontal. As he lifts, make sure he does not lift his sternum off the table, which would indicate that he is rotating his trunk. This starting position lengthens the right pectoralis major to its pain-free end range.

By changing the angle of abduction of the arm, you can emphasize different fibers of the pectoralis major. Less abduction (45 degrees) focuses on the clavicular head; more

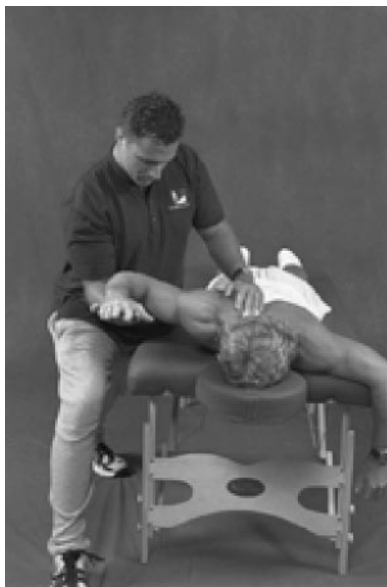


Fig. 6 Starting position for the pectoralis major stretch (right). Be sure the stretcher keeps his sternum in contact with the table. During the isometric phase, the rhomboids and middle traps should be relaxed.

abduction (135 degrees) focuses more on the lower fibers of the sterno-costal head.

2. Support the stretcher's right arm from the elbow to the hand using your right forearm and hand (Fig. 6). Ask the stretcher to begin slowly to attempt to bring his arm down and across his chest, leading with the elbow, isometrically contracting the pectoralis major.
3. After the isometric push, the stretcher relaxes and breathes in. During this time, maintain the arm in the starting position.
4. On the exhale, ask the stretcher to lift his arm higher, keeping the forearm horizontal and his sternum to the table.
5. Repeat two to three times.

Pectoralis major self-stretch

Self-stretching of the pectoralis can be done using a doorway (or any other vertical column) to provide

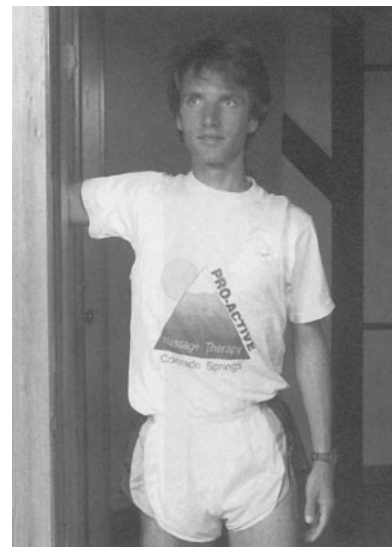


Fig. 7 Pectoralis major self-stretch using a doorway. Keep your back lengthened, not arched.

resistance during the isometric phase.

1. Stand in a doorway and place your forearm against the doorjamb. Be aware of your posture, and use a wide front-to-back stance, keeping your back lengthened and not arched. Using your upper back muscles, pull your arm backwards, away from the doorjamb as far as you can, then take a step or two forward, until your forearm is once again placed against the doorjamb (Fig. 7). This is your starting position.
2. Start slowly and push with moderate effort against the doorjamb, isometrically contracting the pectoralis major. Your arm is not moving, just pushing. Breathe normally. Hold the push for 6–10 seconds, then relax.
3. Take another breath and on the exhale, use your upper back muscles to pull your arm backwards, away from the doorjamb, as far as you can. This further stretches the pectoralis major.
4. Repeat two to three times.

Raise your arm higher or lower to stretch different parts of the pectoralis. Raising your arm higher against the doorjamb will emphasize the pectoralis fibers that attach to the sternum. Having your arm lower on the doorjamb will emphasize the fibers that attach to the collarbone.

Spiral diagonal patterns

Kabat, Knott and Voss noticed that normal movements found in sports and physical activities are spiral-diagonal in nature. They defined these 'mass movement patterns' as 'various combinations of motion ... (that) require shortening and lengthening reactions of many muscles in varying degrees' (Voss et al. 1985). They developed PNF techniques to mimic these natural spiral-diagonal movements, as a way to restore and increase strength, coordination, and flexibility through entire ranges of motion. They named the patterns Diagonal One (D1) and Diagonal Two (D2).

Using the patterns for stretching

The full spiral-diagonal patterns use movement through three planes of motion: extension or flexion, adduction or abduction, and external or internal rotation. When a physical therapist uses these PNF patterns with a patient, the goal is to restore or increase strength and coordination, as well as to increase range of motion.

In facilitated stretching, our primary goal is to increase range of motion. We stretch groups of related muscles simultaneously when we use these three-dimensional patterns, thereby gaining greater benefit in a shorter amount of time.

Working at the end of range

For stretching, we employ only the lengthened position of the pattern,

preventing the limb from going through its range of motion. The stretcher assumes the starting position of the pattern (lengthened range), but her attempts to move the limb through the pattern are isometric; that is, she pushes or pulls in all three planes of motion, but we allow no movement to occur. The stretch to a new range of motion occurs when the stretcher actively moves farther into the lengthening directions of the pattern.

Stretching using diagonal pattern one

This stretch is for increasing range of motion in flexion, adduction, and external rotation of the lower extremity.

1. The stretcher is supine, with his right leg in as much flexion, adduction, and external rotation as possible. His foot is dorsiflexed and inverted, and the toes are extended. This is the starting position for the D1 pattern and lengthens the target muscles to their end range (Fig. 8). These include hamstrings (especially biceps femoris), gluteals, TFL, gastrocnemius (especially lateral head), soleus, and peroneals.
2. Support and stabilize the leg. Remember, your hand contacts give the stretcher proprioceptive cues about which way to push or pull. Your hand positions should match your verbal commands.
3. Direct the stretcher to begin slowly to try to initiate the D1 extension pattern, beginning with internal rotation, then abduction, then extension. ('Begin by rotating, then pull down and out.') Be sure the stretcher keeps both hips flat on the table. Passive rehearsal of the pattern with the stretcher makes it easier for him to understand what to do. During the actual sequence, remember that you resist the

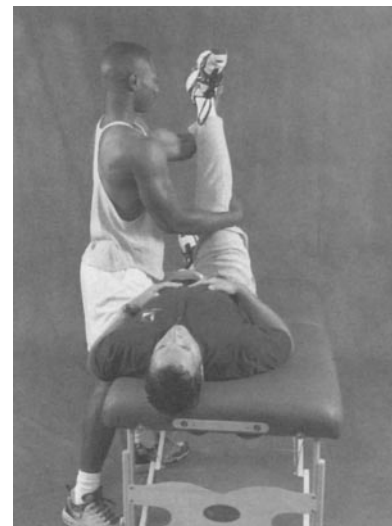


Fig. 8 Starting position for a stretch using the flexion end of Diagonal Pattern One (D1). The stretcher's right leg is flexed, adducted and externally rotated.

stretcher's effort so no movement occurs.

4. After the isometric push, the stretcher relaxes and inhales deeply. As he relaxes, maintain the leg in the starting position.
5. On the exhale, the stretcher moves the hip farther into flexion, adduction, and external rotation. Remember, we want a blend of all three directions to keep moving in a diagonal line. He increases dorsiflexion and inversion of the foot and extension of the toes. Support the leg but do not push to deepen the stretch.
6. Repeat two to three times.

Spiral patterns or single plane stretches

PNF techniques were developed as patterns of spiral movement to increase strength, coordination, and flexibility through entire ranges of motion. Facilitated stretching is based on PNF principles but focuses primarily on increased flexibility.

When should you use patterns, and when should you use single plane stretches? The spiral-diagonal patterns are an excellent way to increase the flexibility and coordination of groups of muscles that act together.

We can also use the patterns as an assessment tool to determine which muscles in a synergistic group are limiting motion, exhibiting weakness, or not firing in the proper sequence. Once these deficiencies are identified, we can modify the patterns to focus on improving the muscular function that is deficient (Adler et al. 1993).

The single plane stretches are more appropriate when we want to develop flexibility or awareness in a specific muscle or muscle group. Single plane stretches can also be used as an adjunct to soft tissue therapy. For instance, you can use these stretches for relaxing hypertonic muscles to reduce the discomfort of deep massage or trigger-point work or in conjunction with deep friction work to release adhesions within or between muscles.

Stretching, some closing thoughts

Even though we all have our favorite styles of stretching, there is ample evidence that all of them work. I believe that flexibility training needs to be based upon the activity we wish to enhance. Therefore, stretching styles should be chosen which will improve the stretcher's functional capacity. A distance runner has different functional needs than a baseball player, who is different than a weight lifter. Pre-activity stretching may need to be different than post-activity stretching.

Frederick and Szymanski (2001), in an article about preparing baseball players to play the game, cite a recent study that tested static stretching vs. dynamic stretching (defined as the act of quickly moving a joint through its range of motion with little resistance). The results of the study showed that 'static stretching produced a significant reduction in eccentric hamstring strength for a time period lasting up to one hour poststretching'. Their conclusion, based on this research and other evidence, is that static stretching should be used as part of a post activity cool down, while dynamic flexibility exercises should be used as part of the warm up before playing.

In my experience, facilitated stretching is an efficient, painless method for improving flexibility quickly. It is ideally suited to the treatment table, especially when combined with other soft tissue work. It also translates well from the table to the client's home program. In the long run, the best stretching method is the one the client will do consistently, since it's only through consistent practice that permanent changes in flexibility can be accomplished.

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