## Flexibility training

Once fitness assessments are completed and all the information has been processed, the fitness professional can now design the client’s exercise program. The first step should be designing the client’s flexibility portion of the exercise program. Clients often require some type of flexibility training, which can be applied to the program’s warm-up and cool-down. This section focuses on foundational concepts of flexibility and how to apply various flexibility techniques with clients.

**What is flexibility?**

Flexibility is defined as the normal extensibility (ability to stretch) of all soft tissues (e.g., contractile and noncontractile) that allow the complete range of motion (ROM) of a joint. Joint ROM is dictated by the type of joint (e.g., ball-and-socket versus hinge joint), and the extensibility of muscles and surrounding soft tissues. An important characteristic of soft tissue is that it will only achieve efficient extensibility if optimal bodily control is maintained throughout the entire joint ROM, which is often termed mobility (flexibility + joint ROM). Flexibility has a major influence on mobility during dynamic motion.

There are various factors that can influence flexibility, which include but are not limited to the following:

* Genetics
* Myofascial (connective) tissue elasticity
* Composition of tendons or skin surrounding the joint
* Joint structure
* Strength of opposing muscle groups
* Body composition
* Sex
* Age
* Activity level
* Previous injuries or existing medical issues
* Repetitive movements.

Poor flexibility can lead to the development of relative flexibility (altered movement patterns), which is the process in which the human movement system (HMS) seeks the path of least resistance during functional movements. A prime example of relative flexibility is seen in people who squat with their feet excessively externally rotated because individuals may have limited ankle ROM that prevents adequate ankle dorsiflexion to perform a squat with proper mechanics. By widening the stance and externally rotating the feet, the amount of dorsiflexion required at the ankle to perform a squatting pattern is decreased. A second example can be seen when people perform an overhead shoulder press with excessive lumbar extension (arched low-back). Individuals who possess limited latissimus dorsi extensibility will have decreased sagittal-plane shoulder flexion (inability to lift arms directly overhead), and as a result, they compensate for this lack of shoulder ROM by extending the lumbar spine to allow them to press the load completely above their head. Relative flexibility can also prevent the nervous system from efficiently recruiting the correct muscle patterns and contractions during the movement.

Flexibility requires extensibility of all soft tissue along with acceptable bodily control. Adequate flexibility combined with joint ROM produces proper mobility of the major bodily regions (e.g., upper and lower extremities). Flexibility training requires a comprehensive approach that integrates various techniques to achieve optimal soft tissue extensibility in all planes of motion. To better understand flexibility training, a few important concepts must first be reviewed, including the HMS, muscle imbalances, and neuromuscular efficiency.

| **Muscle** | **Plane of Motion** | **Movement** |
| --- | --- | --- |
| Latissimus dorsi | Sagittal | Must have proper extensibility to allow for proper shoulder flexion |
| Frontal | Must have proper extensibility to allow for proper shoulder abduction |
| Transverse | Must have proper extensibility to allow for proper external shoulder rotation |
| Biceps femoris | Sagittal | Must have proper extensibility to allow for proper hip flexion, knee extension |
| Frontal | Must have proper extensibility to allow for proper hip adduction |
| Transverse | Must have proper extensibility to allow for proper hip and knee internal rotation |
| Gastrocnemius | Sagittal | Must have proper extensibility to allow for proper dorsiflexion of ankle |
| Frontal | Must have proper extensibility to allow for proper inversion of calcaneus (heel bone) |
| Transverse | Must have proper extensibility to allow for proper internal rotation of femur (thigh bone) |

**Human Movement System review**

The HMS, also known as the kinetic chain, comprises the muscular, skeletal, and nervous systems. The body’s kinetic chain can be further classified into two regional chains: upper kinetic chain (e.g., shoulder, elbow, and wrist and hand) and lower kinetic chain (e.g., hip, knee, and ankle and foot). When referring to movement, the fitness professional can classify the body as a complete kinetic chain or the upper and lower kinetic chains. Optimal alignment and function of each component of the HMS is the cornerstone of a sound training program. If one or more segments of the HMS are misaligned and not functioning properly, predictable patterns of dysfunction develop. These patterns of dysfunction are referred to as postural distortion patterns, which can lead to poor posture, improper movement, and possible injury.

Postural distortion patterns (poor static or dynamic posture) are represented by a lack of structural integrity, resulting from decreased functioning of one (or more) components of the HMS. A lack of structural integrity can result in muscle imbalance, altered force-couple relationships, and altered osteokinematics and arthrokinematics (all discussed in the following section). There are several static postural distortions and poor movement patterns that fitness professionals must be aware of and should be identified while conducting assessments with their clients.

**Muscle imbalances**

Muscle imbalances are alterations in the lengths of muscles surrounding a joint, in which some are overactive (forcing compensation to occur) and others may be underactive (allowing for the compensation to occur). Muscle imbalance can be caused by a variety of mechanisms, which include but are not limited to the following:

* Postural distortions
* Repetitive movement
* Cumulative trauma
* Emotional duress
* Poor training technique
* Poor bodily control
* Biased training patterns.

Muscle imbalances may result in altered reciprocal inhibition, synergistic dominance, and osteo- and arthrokinematic dysfunction. These imbalances can negatively affect overall functioning of the HMS and potentially lead to injury.

Altered reciprocal inhibition

Reciprocal inhibition is a naturally occurring phenomenon that allows movement to take place. Reciprocal inhibition is defined as the simultaneous contraction of the agonist (prime mover) muscle and the relaxation of its antagonist. For example, to perform elbow flexion during a biceps curl, the agonist biceps brachii actively contracts while the antagonist triceps brachii relaxes to allow the movement to occur.

However, altered reciprocal inhibition is an impairment of the HMS, and fitness professionals should aim to correct this phenomenon. Altered reciprocal inhibition is caused by an overactive agonist muscle decreasing the neural drive to its functional antagonist. For example, an overactive hip flexor complex (e.g., iliopsoas, rectus femoris, tensor fascia latae) would decrease neural drive to the hip extensor complex (e.g., gluteus maximus and gluteus medius). In other words, the overactive muscles on the front of the hip are causing the gluteal muscles to become underactive. Another example is overactive chest muscles (e.g., pectoralis major and minor) decreasing neural drive to mid-back muscles (e.g., rhomboids, mid and lower trapezius). In this scenario, the overactive chest muscles (which are shoulder protractors) cause the mid-back muscles (which are shoulder retractors) to become underactive. Altered reciprocal inhibition changes force-couple relationships, produces synergistic dominance, and leads to the development of faulty movement patterns, poor bodily control, and joint dysfunction.

Synergistic dominance

Synergistic dominance is a neuromuscular phenomenon that occurs when synergists take over function for a weak or inhibited prime mover (agonist). For example, if the hip flexor complex is overactive, it leads to altered reciprocal inhibition of the hip extensor complex, which in turn results in increased force output of the synergists for hip extension (hamstring complex) to compensate for the weakened hip extensors. In other words, if the gluteal muscles are underactive and not able to produce force effectively, other muscles, such as the hamstrings, are now recruited more than usual to assist in performing hip extension. The result of synergistic dominance is faulty movement patterns leading to soft tissue and joint dysfunction and eventual injury (such as hamstring strains).

HELPFUL HINT

Synergistic dominance can be a difficult concept to understand. To help, imagine a professional basketball team who has a star player named Michael. Michael is the team’s leading scorer and the team’s best defender. His skills are unquestionably better than his teammates. Now, imagine Michael hurts his ankle and his backup is inserted into the starting lineup. His backup can do all of the things Michael can (e.g., dribble, shoot, defend), but not as well. Consequently, the team is not as productive and does not play its best basketball. The human body works in a similar fashion. For example, if overactive hip flexors decrease neural drive to the hip extensors (gluteal complex), then synergistic muscles (hamstrings) must “pick up the slack” for the inhibited glutei. In other words, the hamstrings have been inserted into the starting lineup to replace the gluteal complex to perform hip extension movements. Yet, the hamstrings are not as well equipped as the gluteal complex to perform hip extension during functional tasks.

Osteokinematic and arthrokinematic dysfunction

Osteokinematics describes how the bones and joints are moving through a ROM. In other words, osteokinematics refers to joint motions we can see, such as flexion, extension, abduction, adduction, or rotation of body segments. Arthrokinematics describes the motion at the joint surfaces. There are three major arthrokinematic joint motions: roll, slide or glide, and spin.

Altered joint motion can be caused by altered length-tension relationships, force-couple relationships, and poor joint surface motion, which results in poor movement efficiency. To achieve efficient motion through a joint’s ROM (osteokinematic), there must be good motion at the joint surface (arthrokinematics) and soft tissue flexibility. For example, a client performs a single-leg squat exercise and demonstrates an excessive knee valgus (knee moves inward) position during the eccentric phase of the movement. The client’s knee joint is mispositioned, preventing the joint surface from moving efficiently. This results in decreased knee joint ROM, excessive biomechanical stress, potential muscle imbalances, and possible compensations at the hip or ankle as the client attempts to successfully perform the movement. Poor form on exercises can be a risk factor for injury.

Poor neuromuscular efficiency

Neuromuscular efficiency is the ability of the nervous system to recruit the correct muscles to produce force, reduce force, and dynamically stabilize the body’s structure in all three planes of motion.

For example, when performing a lat pulldown exercise, the latissimus dorsi (agonist) must be able to concentrically accelerate shoulder extension, adduction, and internal rotation, while the rhomboids (synergists) perform downward rotation of the scapulae (shoulder blades). At the same time, the rotator cuff musculature (stabilizers) must dynamically stabilize the glenohumeral (shoulder) joint throughout the motion. If these muscles collectively do not work efficiently together (force-couples), compensations may ensue, leading to muscle imbalances, altered joint motion, and possible injury. To allow for optimal neuromuscular efficiency, individuals must have proper flexibility in all three planes of motion. This allows for the freedom of movement needed to perform everyday activities effectively, such as bending over to tie shoes or reaching in the top cupboard for dishes.

It is important to note that the nervous system is the controlling factor behind this principle, and specific mechanoreceptors (or sensory receptors) located in the muscles and tendons— specifically the muscle spindles and Golgi tendon organ—help determine muscle balance or imbalance.

Muscle spindles

The muscle spindle is a major sensory organ of the muscle and is composed of microscopic fibers that lie parallel to the muscle fibre. When a muscle is stretched, the muscle spindle records the change in muscle length and speed (rate) of length change and sends this information to the central nervous system (CNS). The function of the muscle spindle is to help prevent the muscle from stretching too far or too fast. This reaction is called the stretch reflex. Thus, the more sudden the change in muscle length, the stronger the stretch reflex or muscle contraction. The muscle spindle helps maintain muscle tone and protects the body from injury.

Golgi tendon organs

The Golgi tendon organ (GTO) is located within the point where the muscle and the tendon meet (musculotendinous junction). The GTO is sensitive to changes in muscular tension and the speed (rate) of tension change. When the GTO activates, it sends information to the CNS, causing the muscle to relax. Prolonged GTO stimulation provides an inhibitory action to muscle spindles (located within the same muscle). This neuromuscular reaction is called autogenic inhibition and occurs when the neural impulses sensing tension are greater than the impulses causing muscle contraction. The GTO prevents the muscle from being placed under excessive stress, which could result in injury.

STRETCH YOUR KNOWLEDGE

Improvements in joint ROM are always due to several factors:

* Mechanical (muscle and tendon factors affecting compliance or stiffness)
* Neural (inhibition of the central nervous system to help the muscle relax)
* Psycho-physiological (stretch tolerance)

**Scientific principles of flexibility**

When a muscle is lengthened, there is a cascade of neurological reactions that occurs that allows the muscle to be stretched. This is called the lengthening reaction. Also, when the body is moving dynamically, there is a sequencing of muscles that are active and inhibited (i.e., as one muscle contracts, its antagonist muscle relaxes). This sequence is called reciprocal inhibition as discussed previously. These physiological reactions are important to understand since they are involved in the different flexibility exercises that are commonly done with clients.

The lengthening reaction

The lengthening reaction is a series of responses that the muscle goes through when being stretched. Often, this reaction is seen when a muscle is stretched and held for a specific amount of time. The steps in the lengthening reaction areas are as follows: (1) The muscle is lengthened (or stretched), and the muscle spindle senses the muscle’s length change; (2) the stretch reflex is activated causing the muscle to contract; (3) as the muscle is held at that position for a prolonged period, the muscle spindle's firing frequency decreases resulting in a relaxation response. The lengthening reaction is often seen with static stretching because static stretches are typically held long enough to override the muscle spindle.

Reciprocal inhibition and stretching

Reciprocal inhibition is a normal neurological reaction that occurs with human movement, whereas altered reciprocal inhibition occurs when an overactive agonist muscle inhibits the antagonist. For stretching, reciprocal inhibition is often involved in different stretches that involve movement, such as active and dynamic stretching. The stretches take advantage of the agonist activation and antagonist inhibition to enhance flexibility, which will be discussed in more detail in the active and dynamic stretching sections later in this section.

HELPFUL HINT

The fitness professional should recognize that the neuromuscular system has several mechanisms to protect muscles from overstretching and allowing for synchronized muscle contraction among different muscle groups. The stretch reflex can protect the muscle from being overstretched. The lengthening reaction allows our muscles to be lengthened or stretched. Reciprocal inhibition allows our muscles to work in synchronous patterns to perform a desired motion. The different types of stretching, such as static, active, and dynamic stretching, incorporate these reactions.

**Scientific rationale for flexibility training**

There are two potential factors that support the need to implement flexibility training: pattern overload and the cumulative injury cycle. It is not uncommon to have clients who do repetitive tasks at work or home that lead to poor flexibility and potential injury. The fitness professional plays a key role in helping correct flexibility deficits and educate the client about the hazards of pattern overload and the risk for cumulative injury.

**Pattern overload**

Muscular imbalances have become common and prevalent in society, which are often caused by pattern overload. Pattern overload is consistently repeating the same pattern of motion, such as baseball pitching, long-distance running, and specific occupations, which with time places abnormal stresses on the body. There are also gym members who train with the same routine repetitively, which may lead to pattern overload and place abnormal stresses on the body. Pattern overload may not necessarily be directly related to exercise. For example, a loading-dock employee who has a particularly repetitive occupation lifting and loading packages all day is prone to pattern overload. Factory, assembly line, and construction workers who repeat the same movement patterns are also susceptible to pattern overload. Even sitting for long periods of time while working on a computer is a repetitive stress.

**Cumulative injury cycle**

It is essential for the fitness professional to understand that poor posture and repetitive, overuse movements can create dysfunction within the connective tissue of the human body. These dysfunctions can eventually lead to an injury and a repair response by the body termed the *cumulative injury*.

Current theory supports the idea that repetitive movements, such as long periods of poor posture, are believed to lead to tissue trauma and inflammation. Inflammation in turn activates the body’s pain response that initiates a protective mechanism, increasing muscle tension and causing muscle spasm. These muscle spasms are not like a calf cramp.

Heightened activity of the CNS and tissue mechanoreceptors and nociceptors (e.g., pain receptors) in the injured area create, in essence, a type of microspasm or tension. As a result of the microspasm, adhesions may begin to form within the myofascial tissues. These adhesions form a weak, inelastic matrix that decreases normal mobility of the soft tissue. The result is altered length-tension relationships, altered force-couple relationships, and joint dysfunction. Left unchecked, these adhesions may begin to form structural changes in the soft tissue that are evident by Davis’s law.

Davis’s law states that soft tissue will model along the lines of. Soft tissue remodels or rebuilds itself with a collagen matrix that forms in a random fashion and not in the same direction as the muscle fibres. If the myofascia is not stimulated by movement, lengthening, and broadening, these connective tissue fibres may act as a roadblock, preventing soft tissue mobility. This creates alterations in normal tissue mobility and causes relative flexibility.

**Flexibility techniques**

Flexibility training is a key component for all training programs. It is used for a variety of reasons, including correcting muscle imbalances, increasing joint ROM, improving the extensibility of the muscles, and improving neuromuscular. There are many types of flexibility training, including self-myofascial techniques, static stretching, active stretching, and dynamic stretching, and all of them can be integrated into an exercise regimen. The focus of flexibility training is to enhance tissue extensibility and joint ROM in those tissues found to be overactive during the assessment process.

STRETCH YOUR KNOWLEDGE

Poor posture, pattern overload, and trauma can create muscle imbalances within specific muscle groups in which certain muscles become overactive or underactive. The overactive muscles should undergo some type of flexibility exercises, whereas the underactive muscles may need to be strengthened. For example, with an anteriorly rotated pelvis, often observed in the lower crossed syndrome, overactive hip flexors help create the anterior pelvic rotation, which subsequently causes lengthening of the hamstring complex. In this case, the hamstrings do not need to be stretched because they are already in a stretched position. Instead, the hip flexors need to be stretched due to their overactive state.

**Self-myofascial techniques**

There are many self-myofascial techniques available for fitness professionals and clients. Perhaps, the most popular is self-myofascial rolling (SMR) with a foam roller, handheld roller, or massage ball. The foam roller seems to be the most popular among fitness and medical professionals, and foam rollers come in many shapes, sizes, and densities.

Myofascial rolling focuses on the nervous system and fascial system, which may produce a mechanical response and a neurophysiological response that influences tissue relaxation and pain in the local and surrounding tissues by activating sensory pathways of the CNS.

For the mechanical effect, the direct roller compression may relax the local myofascia by increasing local blood flow and reducing myofascial restriction and adhesions. For the neurophysiological effect, the direct roller compression may influence tissue relaxation and pain in the local and surrounding tissues by stimulating local mechanoreceptors and pain receptors. These receptors send inhibitory signals to the CNS, triggering a cascade of tissue relaxation and pain blocking responses that affect the tissues being compressed by the roller.

STRETCH YOUR KNOWLEDGE

Delayed-onset muscle soreness (DOMS) often occurs 24 to 72 hours after strenuous exercise, particularly movements that involve a lot of eccentric deceleration. DOMS is caused by mild damage to the muscle cells similar to a grade 1 muscle strain. Signs of DOMS may include pain, restricted movement, stiffness, reduced muscle force capacity, and compensation at other joints. Often, the sore muscle group will send pain signals up to the brain, which are processed and translated into a specific level of pain or discomfort. Researchers postulate that myofascial rolling may provide a pain-blocking effect by stimulating other sensory receptors (e.g., mechanoreceptors), which send their own signals to the brain. These new signals may create a decreased sensation of DOMS by overriding the pain signal sent from the pain receptors involved in the sore muscle.

Self-myofascial rolling is a flexibility technique that focuses on the neural system and fascial system in the body (or the fibrous tissue that surrounds and separates muscle tissue). By applying gentle force to an adhesion, casually referred to as a knot, the elastic muscle fibres are altered from a bundled position (which causes the adhesion) into a straighter alignment with the direction of the muscle or fascia. The gentle pressure from the implement used, such as a foam roller, will stimulate the GTO and create autogenic inhibition, decreasing muscle spindle excitation and releasing the tension of the underlying musculature. In other words, gentle pressure similar to a massage helps to release unwanted muscular tension.

It is crucial to note that when a person is using a foam roller, they should find a tender spot and sustain pressure on that spot for a minimum of 30 seconds, which will increase the relaxation response. It may take longer, depending on the client’s ability to consciously relax. Self-myofascial rolling is suggested before stretching because it may potentially improve the effectiveness of static stretching techniques. In addition, self-myofascial rolling can be used during the cool-down process.

| **Type of Stretch** | **Mechanism of Action** | **Training Variables** |
| --- | --- | --- |
| Self-myofascial rolling | Autogenic inhibition | 1–3 sets  Hold each tender area for 30 seconds |

**Foam rolling exercises**

SMR: Calves

Crossing one leg on top of the other is optional and is used to increase pressure to the calf. Roll along the length of the calf muscles.

SMR: Peroneals

Stacking the legs is optional and is used to increase pressure on the peroneals. Roll along the length of the muscle. Avoid rolling over the knee joint.

SMR: Hamstrings

While sitting, the target leg is straight with the roller underneath the posterior thigh, and the opposite knee is flexed. Roll along the length of the muscle. Avoid rolling over the knee joint. Using a massage ball instead of a foam roller is a progression for this exercise and can help pinpoint tender areas.

SMR: Quadriceps

The client is in the plank position with knees straight and roller under the quadriceps. Roll along the length of the muscle. This exercise can be performed bilaterally (both legs) or unilaterally (one leg at a time). Avoid rolling over the knee joint.

SMR: Adductors

To perform this technique correctly, the foam roller should be placed perpendicular to the inner thigh. Roll the length of the muscle. Avoid rolling over the knee joint.

SMR: Lateral Thigh

The client is side-lying with the roller under the lateral thigh. The opposite hip and knee are bent with foot flat on the floor. Roll along the length of the lateral thigh. Avoid rolling over the hip or knee joint. This exercise can be too painful for some individuals. If this occurs, opt for a handheld roller instead.

SMR: Tensor Fascia Latae

The tensor fascia latae (TFL) is a small muscle, so this technique does not require lots of movement. To target the TFL, roll along the front and slightly lateral (outside) part of the upper thigh (just below the pelvis). Avoid rolling over the hip bone.

SMR: Piriformis

The piriformis is a small muscle of the posterior hip that runs horizontally across the pelvis. To target the piriformis, sit on top of the foam roll, positioned on the back of the hip. Cross one foot to the opposite knee and lean into the hip of the crossed leg. Roll back and forth over the muscle. Avoid rolling over the hip bone.

SMR: Thoracic Spine

The client keeps the bridge position and rolls along the thoracic spine. The client can choose to support their head in their hands (as shown) or cross their arms in front of their chest. This is a good technique to gain thoracic extension of the spine. Avoid rolling over the low-back (lumbar spine) and neck (cervical spine).

SMR: Latissimus Dorsi

To target the latissimus dorsi, lie on the floor on one side with the arm closest to the floor outstretched and thumb facing upward. Place the foam roller under the armpit area (axillary region) and slowly roll until a tender spot is identified.

**Precautions and contraindications**

Before programming self-myofascial techniques, fitness professionals should consider any medical precautions or contraindications. Medical precautions are any medical conditions that could be unsafe for flexibility exercise. In the presence of a medical precaution, the fitness professional may be able to modify an exercise for the client to be safe. For example, foam rolling for a client with osteopenia (a precursor to osteoporosis) is considered a precaution due to the risk of causing bone injury. As a modification, the fitness professional may choose to teach low-intensity, static stretching of the legs and arms to the client. The precautions are not all inclusive, as other precautions may be present with specific clients. Before recommending flexibility exercises, the fitness professional must use good judgment and communicate with the client and supervising medical professional to obtain proper clearance.

|  |  |  |
| --- | --- | --- |
| Medical Precautions | | |
| Hypertension (controlled) | Osteopenia | Pregnancy |
| Diabetes | Varicose veins | Rolling over bony prominences or regions |
| Abnormal sensations (e.g., numbness) | Sensitivity to pressure | Recent injury or surgery |
| Inability to position the body or perform the exercise correctly | Young children | Elderly |
| Scoliosis or spinal deformity | Medications that may alter client sensations | Fibromyalgia |

Contraindications are medical conditions that would make any type of flexibility exercise unsafe for the client to participate in. Self-myofascial techniques should not be conducted in the presence of a contraindication to ensure client safety. It is important to note that some conditions, such as pregnancy, diabetes, varicose veins, recent injury or surgery, and hypertension, may be considered either precautionary or contraindicative depending on the client’s status. The contraindications listed here are not all inclusive as others may be present with specific clients. Therefore, a medical professional should be consulted before proceeding with self-myofascial techniques in the presence of a medical contraindication.

| **Medical contraindications** | | |
| --- | --- | --- |
| Skin rash, open wounds, blisters, local tissue inflammation, bruises, or tumors | Deep vein thrombosis, osteomyelitis (i.e., infection of bone tissue) | Osteoporosis |
| Bone fracture of myositis ossificans (i.e., bone forming within muscle tissue) | Cancer or malignancy | Hypertension (uncontrolled) |
| Acute or severe cardiac, liver, or kidney disease | Acute infection (viral or bacterial), fever, or contagious condition | Neurologic conditions resulting in loss or altered sensation |
| Bleeding disorders | Systemic conditions (e.g., diabetes) | Recent surgery or injury |
| Connective tissue disorders | Peripheral vascular insufficiency or disease (i.e., blood circulation disorder) | Medications that thin the blood or alter sensations |
| Direct pressure over surgical site or hardware | Chronic conditions (e.g., rheumatoid arthritis) | Direct pressure over face, eyes, arteries, veins (e.g., varicose veins), or nerves |
| Pregnancy (consult physician) | Severe scoliosis or spinal deformity | Extreme discomfort or pain felt by client |

**Static stretching**

Static stretching is the process of passively taking a muscle to the point of tension and holding the stretch for a minimum of 30 seconds. This is a traditional form of stretching that is most often used in current fitness professions. It combines low force with longer duration stretch times. By holding the muscle in a stretched position for a prolonged period, the muscle spindle becomes inhibited resulting in a relaxation response. This allows the muscle to relax and provides for a better lengthening reaction. In fact, static stretching may impact many sensory mechanisms within the nervous system to facilitate a greater stretch tolerance. In addition, contracting the antagonistic musculature while holding the stretch can reciprocally inhibit the muscle being stretched, allowing it to relax and enhance the effectiveness of the stretch. For example, when performing the kneeling hip flexor stretch, an individual can contract the hip extensors (gluteus maximus) to reciprocally inhibit the hip flexors (psoas, rectus femoris), allowing for greater lengthening of these muscles. Another example would be to contract the quadriceps when performing a hamstring stretch. Static stretching should be used to decrease the muscle spindle activity of an overactive muscle before and after activity. Various static stretching techniques are described in the following section.

| **Type of Stretch** | **Mechanism of Action** | **Training Variables** |
| --- | --- | --- |
| Static stretch | Stretch tolerance and/or reciprocal inhibition (depending how stretch is performed) | 1–3 sets  Hold each stretch for 30 seconds |

STRETCH YOUR KNOWLEDGE

Does Static Stretching Impair Strength and Power?

There has been much debate in the research and sport science communities regarding the effects of static stretching on strength and athletic performance. Several studies have cited that static stretching impairs strength and power and recommend avoiding this technique prior to exercise or sport competition.

Looking at the research more closely, static stretching, when performed acutely and in isolation, can temporarily impair muscular power due to its relaxation response. This is especially true when stretches are held for extended periods (2 minutes or longer) and performed in an acute fashion (every now and again) and are the only form of exercise performed prior to maximal effort (sprinting or jumping).

However, static stretches, when performed for 30 seconds or less in a chronic fashion (included prior to every workout) and followed by dynamic activities, does not impair athletic performance.

As such, NASM recommends performing static stretching, especially when individuals exhibit limited joint ROM or muscle imbalances. Following are some recommendations.

Static stretches:

* Should be held for 30 seconds
* Only used on muscles identified as overactive during the assessment process
* Followed by additional warm-up protocols, such as low-intensity core and balance exercises or dynamic stretching, to regain motor neuron excitability

**Static stretches**

Static Gastrocnemius Stretch

Stand in a lunge position with both feet pointing straight forward. Make sure to keep the rear foot flat on the ground. Do not let the heel rise. Shift weight forward until a stretch is felt in the rear calf muscle.

Static Soleus Stretch

Stand in a lunge position with both feet pointing straight forward and back knee slightly flexed. Make sure to keep the rear foot flat on the ground. Do not let the heel rise up. Shift weight forward until a stretch is felt in the rear calf muscle.

Static 90/90 Hamstring Stretch

Lie supine with one hip flexed 90 degrees (target leg) and the opposite leg straight and flat on the floor. Straighten the target leg until a mild stretch is felt in the hamstrings. The use of a rope or band is suggested. The stretch should not cause pain or extreme discomfort.

Static Supine Biceps Femoris Stretch

Lie supine with one hip flexed 90 degrees (target leg) and the opposite leg straight and flat on the floor. Next, adduct the target leg across the body and extend the knee until a mild stretch is felt in the lateral hamstrings. The stretch should not cause pain or extreme discomfort. Keep both shoulders flat on the ground during this stretch. Avoid rotating the torso toward the stretched leg.

Static Standing Biceps Femoris Stretch

Use a low box or step to perform this stretch. Place one leg on top of the box in an adducted and internally rotated position. Then, locking the hands together, slowly rotate the torso in the opposite direction. The stretched leg does not need to be elevated above hip height. This stretch emphasizes the lateral hamstring.

Static Seated Ball Adductor Stretch

Sit on a stability ball in a lateral lunge position until a stretch is felt in the inner thigh area. Posteriorly rotate the pelvis and draw in the abdominals when performing this stretch.

Static Standing Adductor Stretch

Stand with legs apart and shift weight to one side (lateral lunge position) until a stretch is felt in the inner thigh of the target leg. Posteriorly rotate the pelvis and draw in the abdominals when performing this stretch.

Static Adductor Magnus Stretch

While standing with one foot on a bench or plyo box, reach down to a comfortable position without excessively rounding the spine until a stretch is felt.

Static Standing TFL Stretch

Stand in a staggered stance with the front leg slightly bent and rear leg straight. Externally rotate the rear foot, draw in the navel, and posteriorly rotate the pelvis. Squeeze the gluteal muscles of the side being stretched. As a progression, raise the arm (on the same side as the back leg) up and over to the opposite side while maintaining pelvis position. Hold side bend position as illustrated.

Static Kneeling Hip Flexor Stretch

Kneel with front and back legs flexed at a 90-degree angle. Draw in the navel and posteriorly rotate the pelvis. Squeeze the gluteal muscles of the side being stretched. As a progression, raise the arm (on the same side as the back leg) up and over to the opposite side while maintaining pelvis position. Hold side bend position and slowly rotate posteriorly as illustrated. To emphasize the TFL, externally rotate the rear leg, whereas to emphasize the psoas, internally rotate the rear leg.

Static Supine Piriformis Stretch

Lie supine and cross one leg over the opposite leg that is straight. Keep the low-back in a neutral position while bringing the knee toward the opposite shoulder.

Static Erector Spinae Stretch

Sit with one leg crossed over the other and opposite knee straight. Rotate the torso to the right when the right leg is crossed over the left leg. Rotate to the left when the left leg is crossed over the right leg.

Static Ball Latissimus Dorsi Stretch

In the quadruped position, put one arm on top of a stability ball and roll forward until a stretch is felt. Posteriorly rotate the pelvis, point the thumb up toward the sky, and draw in the abdominals when performing this stretch.

Static Pectoral Stretch

Standing with one arm in a 90/90 arm position, lean forward until a stretch is felt in the anterior shoulder and chest area. Do not allow the shoulders to elevate (shrug) during this stretch.

Static Upper Trapezius/Scalene Stretch

Grasp the top of the head with one hand and laterally flex toward the same shoulder. Do not allow the chin to jut forward or shoulders to shrug during this stretch.

Static Levator Scapulae Stretch

Grasp the top of the head with one hand and laterally flex toward the same shoulder. Next, slightly rotate the head to look in the axillary (armpit) region as shown. Do not allow the chin to jut forward or shoulders to shrug during this stretch.

Static Sternocleidomastoid Stretch

Grasp the top of the head with one hand and laterally flex toward the same shoulder. Rotate the head up and away as shown. Only perform this stretch to the point of mild tension. Do not allow the chin to jut forward or shoulders to shrug during this stretch.

CRITICAL

When assisting clients during a stretch, the fitness professional must be careful not to overstretch the muscle. Overstretching can occur if the muscle and joint are taken beyond their physiological limits. Aggressive stretching can result in tissue and joint trauma. The general signs of overstretching include but are not limited to (1) prolonged joint pain or muscle soreness lasting more than 24 hours after stretching, (2) edema (swelling) or inflammation of the involved area, and (3) excessive muscle or joint pain during the stretch. Caution needs to be taken when conducting flexibility exercises with clients who have a current or preexisting joint or muscle injury.

**Active Stretching**

Active stretching is the process of using agonists and synergists to dynamically move the joint into a ROM. This form of stretching increases motor neuron excitability, creating reciprocal inhibition of the muscle being stretched. The active supine hamstring stretch is a good example of active stretching. The quadriceps extend the knee. This enhances the stretch of the hamstrings in two ways. First, it increases the length of the hamstrings. Second, the contraction of the quadriceps causes reciprocal inhibition (decreased neural drive and muscle spindle excitation) of the hamstring complex, which allows it to elongate. Active stretches are suggested for pre-activity warm-up, such as before sports competition or high-intensity exercise. If an individual possesses muscle imbalances, active stretching should be performed after self-myofascial techniques and static stretching for muscles determined as overactive during the assessment process. Typically, 5 to 10 repetitions of each stretch are performed and held for 1 to 2 seconds each. Detailed explanations of various active-isolated techniques are described in the following section.

| **Type of Stretch** | **Mechanism of Action** | **Training Variables** |
| --- | --- | --- |
| Active stretch | Reciprocal inhibition | 1–3 sets  Hold each stretch for 1–2 seconds and repeat for 5–10 repetitions |

HELPFUL HINT

Static and active stretches typically require the same body position and movement patterns. However, static stretches involve holding each stretch for 30 seconds, whereas active stretches require holding the stretch for only 1 to 2 seconds and repeating the motion for 5 to 10 repetitions. Active stretching can be considered a progression from static stretching.

**Active stretches**

Active Gastrocnemius Stretch

Stand with back hip and knee straight (target leg). The opposite hip and knee are flexed and swing back and forth across the body. This motion causes rotation at the back knee and eversion and inversion of the foot and ankle. Repeat for the desired number of repetitions.

Active Soleus Stretch

Stand with back hip and knee slightly flexed (target leg). The opposite hip and knee are flexed and swing back and forth across the body. This motion causes rotation at the back knee and eversion and inversion of the foot and ankle. Repeat for the desired number of repetitions.

Active 90/90 Hamstring Stretch

Lie supine with one hip flexed 90 degrees (target leg). Straighten the target leg until a mild stretch is felt in the hamstrings. The stretch should not cause pain or extreme discomfort. Repeat for the desired number of repetitions.

Active Supine Biceps Femoris Stretch

Lie supine with one hip flexed 90 degrees (target leg) and the opposite leg straight and flat on the floor. Next, adduct the target leg across the body and extend the knee until a mild stretch is felt in the lateral hamstrings. The stretch should not cause pain or extreme discomfort. Keep both shoulders flat on the ground during this stretch. Avoid rotating the torso toward the stretched leg. Repeat for the desired number of repetitions.

Active Standing Adductor Stretch

Stand with legs spread apart and shift weight to one side (lateral lunge position) until a stretch is felt in the inner thigh area. Posteriorly rotate the pelvis and draw in the abdominals when performing this stretch. Repeat for the desired number of repetitions.

Active Ball Adductor Stretch

Sit on a stability ball in a lateral lunge position until a stretch is felt in the inner thigh area. Posteriorly rotate the pelvis and draw in the abdominals when performing this stretch. Repeat for the desired number of repetitions.

Active Adductor Magnus Stretch

While standing with one foot on a bench or plyo box, reach down to a comfortable position without excessively rounding the spine until a stretch is felt. Repeat for the desired number of repetitions.

Active Standing TFL Stretch

Stand in a staggered stance with the front leg slightly bent and rear leg straight. Externally rotate the rear foot, draw in the navel, and posteriorly rotate the pelvis. Squeeze the gluteal muscles of the side being stretched. As a progression, raise the arm (on the same side as the back leg) up and over to the opposite side while maintaining pelvis position. Hold side bend position and repeat for the desired number of repetitions.

Active Kneeling Hip Flexor Stretch

Kneel with front and back legs flexed at a 90-degree angle. Draw in the navel and posteriorly rotate the pelvis. Squeeze the gluteal muscles of the side being stretched. As a progression, raise the arm (on the same side as the back leg) up and over to the opposite side while maintaining pelvis position. Hold side bend position and slowly rotate posteriorly as illustrated. To emphasize the TFL, externally rotate the rear leg, whereas to emphasize the psoas, internally rotate the rear leg. Repeat for the desired number of repetitions.

Active Latissimus Dorsi Ball Stretch

In the quadruped position, put one arm on top of a stability ball and roll forward until a stretch is felt. Posteriorly rotate the pelvis, point the thumb up toward the sky, and draw in the abdominals when performing this stretch. Repeat for the desired number of repetitions.

Active Pectoral Stretch

Standing with one arm in a 90/90 arm position, lean forward until a stretch is felt in the anterior shoulder and chest area. Do not allow the shoulders to elevate (shrug) during this stretch. Repeat for the desired number of repetitions.

Active Upper Trapezius/Scalene Stretch

Grasp the top of the head with one hand and laterally flex toward the same shoulder. Do not allow the chin to jut forward or shoulders to shrug during this stretch. Repeat for the desired number of repetitions.

Active Levator Scapulae Stretch

Grasp the top of the head with one hand and laterally flex toward the same shoulder. Next, slightly rotate the head to look in the axillary (armpit) region as shown. Do not allow the chin to jut forward or shoulders to shrug during this stretch. Repeat for the desired number of repetitions.

Active Sternocleidomastoid Stretch

Grasp the top of the head with one hand and laterally flex toward the same shoulder. Rotate the head up and away as shown. Only perform this stretch to the point of mild tension. Do not allow the chin to jut forward or shoulders to shrug during this stretch. Repeat for the desired number of repetitions.

TRAINING TIP

When performing static and active stretches, it is important to maintain ideal posture. This requires performing a chin tuck and keeping the head directly over the shoulders. Do not allow the head to jut forward. This position keeps the cervical spine in a neutral position. In addition, perform the drawing-in manoeuvre (slightly pull the navel inward) to help maintain ideal stabilization of the spine.

**Dynamic Stretching and Controversial Stretches**

Dynamic stretching uses the force production of a muscle and the body’s momentum to take a joint through the full available ROM. Dynamic stretching uses the concept of reciprocal inhibition to improve soft tissue extensibility. One can perform one set of 10 repetitions using 3 to 10 dynamic stretches. Dynamic stretching is also suggested as a warm-up before athletic activity. If an individual does possess muscle imbalances, self-myofascial techniques and static stretching should precede dynamic stretching for overactive muscles identified during the assessment process. It is recommended that the client has good levels of tissue extensibility, core stability, and balance capabilities before undertaking an aggressive dynamic stretching program. Detailed explanations of various dynamic stretches are presented in the following section.

|  |  |  |
| --- | --- | --- |
| Type of Stretch | Mechanism of Action | Training Variables |
| Dynamic stretching | Reciprocal inhibition | 1 set  10–15 repetitions  3–10 exercises |

HELPFUL HINT

Dynamic stretches are often used in a specific warm-up protocol. These stretches tend to mimic movements used during an exercise session or sport competition. For example, a fitness professional may have a client perform a series of pushups prior to initiating the bench press exercise or hip swings prior to performing squats.

When implementing dynamic stretching, it is important to adequately prepare the client for activity while simultaneously avoiding undue fatigue. The goal is to prepare the body for more intense activity rather than cause breathlessness and exhaustion.

**Dynamic stretches**

Prisoner squat

With arms behind the head and feet approximately shoulder-width apart, perform a bodyweight squat. As a progression to this exercise, add a calf raise at the top position after performing the squat.

Multiplanar Lunge with Reach

Perform the lunge in all three planes of motion: sagittal, frontal, and transverse. In other words, perform a forward lunge, lateral lunge, and turning lunge.

Lunge with Rotation

Perform a forward lunge with trunk rotation toward the outside portion of the forward leg. This exercise can be performed with or without an external load, such as a medicine ball.

Tube Walking: Side to Side

Place elastic tubing around the knees, maintain a quarter squat position, and sidestep for the desired number of repetitions in each direction. Make sure the knees are tracking in line with the second and third toes. Do not allow the knees to cave inward. This exercise primarily targets the hip abductors, such as the gluteus medius. The band can also be placed around the ankles (as shown) as a progression to this exercise.

Leg Swings: Front to Back

In standing position, swing one leg in a controlled pendulum fashion to the front and back, only lifting the leg as high as can safely be controlled. Keep a tall, upright posture with the abdominals drawn in during the duration of the exercise.

Leg Swings: Side to Side

In standing position, swing one leg in a controlled pendulum fashion from side to side. Like front to back hip swings, keep a tall, upright posture with the abdominals drawn in during the duration of the exercise.

Frankenstein

This technique is performed while walking forward with arms stretched out away from the body. Only lift each leg as high as can be safely controlled while maintaining ideal posture. Keep a neutral back without leaning to the left or right. This exercise helps stretch the hamstrings.

High Knee

This technique is performed while walking forward. With each step, flex the hip as high as can be controlled, grasping the knee at the top with both hands. Be sure to pause at the top and switch legs with each step.

Push-Up with Rotation

Perform a bodyweight push-up with a trunk rotation at the top. Keep the abdominals drawn in, chin tucked, and spine in a neutral position throughout the exercise.

Ball Russian Twist

While bridging on a stability ball, perform trunk rotation. This exercise targets the internal and external obliques in addition to the gluteus maximus because it requires the participant to maintain a bridged position. The exercise can be performed with or without external load, such as using a medicine ball.

Arm Circles

Perform arm circles in both directions using a slow to moderate speed.

Jumping Jacks

When performing jumping jacks as a dynamic warm-up, the goal is to slightly elevate heart and respiration rates without causing undue fatigue.

Jump Rope

Many movements can be performed with a jump rope. Choose movements your client can safely perform. It is also important to keep the intensity relatively low to moderate when integrating this exercise into a warm-up routine.

STRETCH YOUR KNOWLEDGE

Flexibility training is a key component to a comprehensive fitness program for clients of all levels. Often, flexibility is implemented in the warm-up or cool-down phase of a client’s workout. Depending on individual needs, a combination of flexibility exercise may provide the best results. Researchers have found that combining static and dynamic stretching reduces the risk for muscle injury and increases flexibility. This combination does not have any detrimental effects on muscle performance, which makes it ideal for a warm-up or cool-down. Researchers also found that short bouts of self-myofascial rolling increase flexibility, enhance pre-exercise muscle performance, and decrease postexercise soreness and fatigue. The fitness professional should consider a combination of interventions to meet individual client needs. Ideally, self-myofascial rolling and static stretching should be performed prior to active or dynamic stretching to first address restricted ROM.

**Controversial Stretches**

Although flexibility training has numerous benefits, performing certain types of stretches may be a risk for injury. Although most stretches are very safe when performed correctly with proper posture and technique, there are a few controversial stretches that may be potentially dangerous.

Inverted hurdler’s stretch

This stretch is thought to place high stress on the inside of the knee (medial collateral ligament) and may cause pain and stress on the patella (kneecap) (right knee in Figure 14-18). This stretch should not be performed by anyone with a history of knee or low-back pain or injury. Health professionals believe this stretch should not be performed by most patients or general wellness clients.

Plow

The plow exercise is a common posture from yoga. Because of the inverted nature of this stretch (head is lower than the hips), this stretch places high stress on the neck and spine. If this stretch is not done with exact technique, it may place the spine at risk of injury. Clients with a history of neck or back injury should not perform this stretch owing to the high stress it places on these structures. This position should also be avoided by individuals with high blood pressure (hypertension).

Shoulder stand

The shoulder stand is another common posture from yoga and another inverted stretch. As with the plow, this position places high stress on the neck, shoulders, and spine. It should be avoided in patients with hypertension or any history of neck or spine injury, or if exact technique is not used.

Straight-leg toe touch

The straight-leg toe touch is one of the most common stretches for the hamstring complex. This position may place the vertebrae and the cartilage discs in the low-back under high stress. Any client or patient with a history of herniated discs or nerve pain that runs down the back of the leg should avoid this stretch. In addition, clients with poor flexibility may attempt to hyperextend the knees during this stretch, which may place high stress on the ligaments of the knee.

Arching quadriceps

The arching quadriceps stretch is designed to stretch the quadriceps and hip flexors. This position places very high stress on the kneecap and the other tissues on the front of the knee joint. Any client with a history of knee injury should avoid this stretch. Owing to the high stress (compression) of the kneecap into the knee during this stretch (which may cause damage to the cartilage), most healthcare professionals discourage anyone from performing this exercise.

The fitness professional must recognize that some individuals, such as athletes, may need to perform the stretches because the position is required for their sport or activity. For instance, the inverted hurdler’s stretch mimics the position of a hurdler going over a hurdle. Others are traditional positions used in martial arts, gymnastics, or yoga. However, for most clients, there are safer positions that can be used to stretch the targeted muscles. Therefore, all clients should be properly educated about stretching technique and posture, and the safest exercises should be used to meet the goals of the exercise program.