FLEXABILITY™

EFFECTIVE STRETCHING AND BACK PAIN PREVENTION

METHOD

TECHNOGYM®
The Wellness Company™

Index

March 2007 edition

FLEXability™: the future of stretching

Flexibility training in the form of stretching exercises is a universal practice adopted both by athletes who perform either at competitive or amateur levels, and those who do little or no sport at all.

Stretching involves assuming specific positions, often without the assistance of a partner or other apparatus. It may not be particularly suitable for subjects with very limited flexibility or, conversely, for those who are especially flexible.

Furthermore, in the case of certain exercises which require the intervention of a partner in order to achieve the final position, the amount of strength applied may vary significantly and be difficult to manage, especially if the partner is different each time.

With conventional stretching, it is not possible to accurately measure one's initial level of flexibility or rate of progression; it is not possible to set target positions for each individual session, nor to apply additional tension from time to time. In fact, in the case of conventional stretching, it is impossible to reproduce the same position each time or to vary the progression of the stretch.

FLEXability™ equipment and the accompanying Method have been designed especially to solve these problems. They make it possible to accurately measure and reproduce positions, whilst stimulating the subject to continually improve his or her level of flexibility.

1.0 Flexibility

Flexibility can be defined as a joint's ability to move freely through a full excursion of its possible movement or range of motion (ROM).

Each joint has its own maximum possible ROM. These are limited by anatomical and functional factors which can be strongly conditioned by the type of activity, or inactivity, to which the joints are subjected.

Joint mobility depends on a series of factors, including the elasticity of tissues (muscles, tendons, ligaments), the elasticity of intramuscular connective tissue or membranes which form fasciae and aponeuroses, genetic causes such as the actual morphology of the joint, the tension of antagonistic musculature and finally neuromuscular coordination.

Flexibility can be maintained, and in some cases improved, by means of a series of exercises which engage the passive and active structures that make up the joint.

Two distinct types of flexibility may be identified: static and dynamic.

Static flexibility concerns the ability to hold a specific position within the ROM, without any consideration as to the speed of movement. By contrast, dynamic flexibility entails the movement of the joint itself; other factors are therefore involved, such as strength (to move the skeletal frame), power, neuromuscular coordination and tissue viscosity.

1.1 Benefits of flexibility training

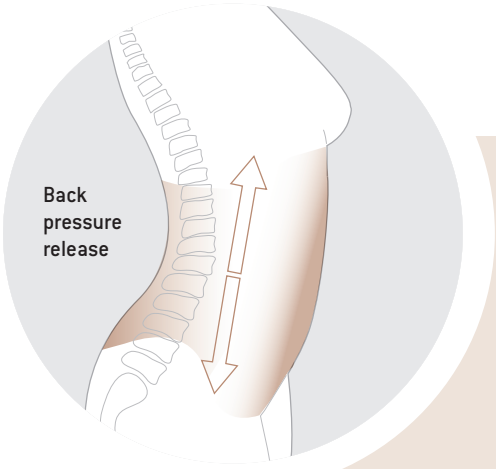
According to guidelines from the American College of Sports Medicine, good flexibility is, together with cardiovascular efficiency and muscular strength, one of the essential components of physical fitness. However, the benefits of physical fitness go beyond strictly functional aspects and contribute to physical and mental wellness as a whole.

We can summarise these benefits as follows:

• Improvement in posture

Increased flexibility helps bone segments to realign after they have been incorrectly positioned for a long period of time, as is often the case in modern life. In such incorrect positions, muscles and osteoarticular structures often become shortened for prolonged periods; over time, the body interprets this shortened length as the correct and natural length of the muscle in functional and structural terms. One common example is the iliopsoas muscle, which in most instances stays contracted whilst the subject remains seated. It then resists stretching when the subject stands upright.

In fact, when stretching contracted muscles - which is necessary to regain the correct posture - an active-muscle resistance and a passive-structural resistance are generated. These resistances oppose the reattainment of a natural posture, making it impossible, more tiring or simply more energy-consuming to achieve. Good flexibility therefore makes it easier to regain a good posture, as well as maintaining it with less effort.



• Reduction/treatment of lower back problems

Amongst the many causes of frequent lower back pain, the limited elasticity of the muscles which engage the spinal column and pelvis plays a leading role.

The shortening of certain muscles, often caused by maintaining incorrect postures for extended periods, can alter the curvature of the spine, leading to the possible overloading of certain structures. In the same way, changes in the elasticity of the muscles which act on the pelvis can cause both static and dynamic alterations that may result in lower back pain. The correct and safe execution of flexibility exercises over an extended period of time makes it possible to prevent, and possibly contribute to the treatment of lower back problems.

This is achieved by relieving painful tension in certain muscles and realigning the vertebrae into their correct physiological position, thereby alleviating stress on the posterior facet joints and reducing the risk of intervertebral disc protrusions.

• Improvement in physical efficiency and performance

More flexible antagonistic muscles less energy from the antagonistic muscles to contract along the full arc of movement. This is beneficial to the fluidity and economic movement of the athletic gesture which must be performed (Shrier, 2004).

In fact, if, during an athletic gesture, the agonistic muscle action is partly resisted by stiff antagonistic muscles, more energy is consumed overall and a braking action occurs, limiting joint excursion and preventing the joint from moving freely through its optimal ROM. Conversely, highly flexible antagonistic muscles enable the optimal performance of the gesture, in other words maximum possible fluidity and economy of movement.

• Reduction in the risk of injuries

Many experts agree that improved flexibility leads to a reduction in the risk of muscle and joint trauma during physical activity, both in athletes and beginners (Tacker et al.,2004).

During the performance of extremely dynamic gestures, stiff antagonistic muscles are in fact subjected to massive stresses, to the extent that they sometimes exceed their mechanical limits. This may result in structural injury of varying severity.

Poor flexibility even makes motor coordination extremely difficult, leading to poor control with a greater likelihood of muscle injury or joint sprains.

On the other hand, optimum flexibility, which is essential in active subjects, contributes to sustaining a long sporting career without injuries of this type.

• Reduction in stress

A stretching session in itself creates a general feeling of relaxation, both by relieving tension in the actual muscle and indirectly reducing the basal tone of all the body's musculature. It has the added effct of slowing the heart rate.

These last effects are above all evident in the case of comfortable stretching postures, which are held for long periods and are accompanied by controlled breathing. In fact, it is difficult to relax the muscles if the positions assumed are difficult to maintain, whether due to balance requirements or tension in muscles from other regions, or simply due to pain caused by pressure at certain contact points.

- **Pre-exercise warm-up**

Stretching at the start of a workout session enables the subject to progressively change from a resting state to an active state, thanks also to the thermometabolic effect generated by muscle stretching. Furthermore, the pre-exercise session enables the neuromuscular system to 'memorize' its true maximum ROM limits, which are probably very different from the limits maintained between exercise sessions.

- **Cooling down**

At the end of a workout in which the basal tone of muscles has considerably increased, stretching enables the muscles to return to their initial level of flexibility by reducing muscle tone.

At the same time, if positions can be held comfortably for a sufficient length of time, it is possible to achieve a considerable reduction in overall muscle tone.

1.2 Improving flexibility

Flexibility can be improved by using a series of muscle extension or stretching techniques. Stretching involves the extension of the musculo-tendinous structure in order to diminish its resistance to extension, thereby increasing its ROM.

Resistance to extension or the feeling of resistance during stretching exercises originates from the muscle's contractile component and, in the case of excessive or prolonged lack of flexibility, from intra and extra-muscular connective components (tendons, ligaments, joint capsules, fasciae and aponeuroses).

In order to achieve sustained effects from stretching exercises, it is necessary to prolong the exercise until such effects are obtained both in the muscular component and the connective component.

The two fundamental factors which permit long-term improvements in flexibility are the intensity and duration of the stretching exercise.

1.3 Reflexes involved in muscle stretching

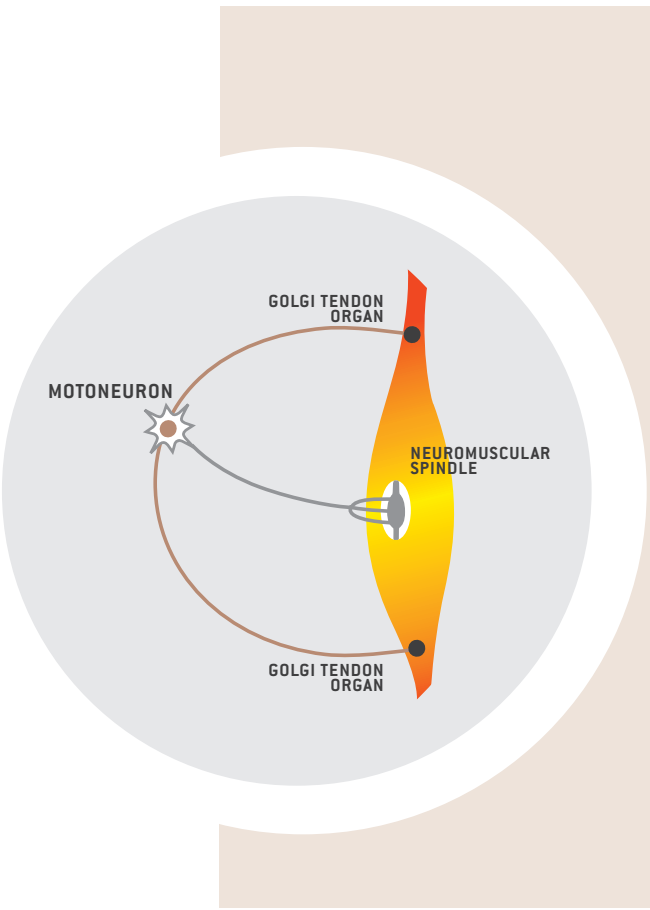
Managing the stretch of muscle fibres is dependent on a series of neurophysiological reflexes. The nerve receptors responsible for this reflex are primarily composed of neuromuscular spindles which run parallel to the muscle fibres.

The Golgi tendon organs, which are found in the junction between muscle and tendon, appear to intervene in the case of particularly excessive stretches by inhibiting muscular contraction. Each of these receptors is sensitive to stretching and helps protect the muscle against potential injury.

The neuromuscular spindles, which run parallel to the fibres, are subjected to the same stretch and send signals to the peripheral nervous system relating to the status of the muscle stretch. If the extension is deemed to be excessive - and therefore potentially dangerous - the spinal cord sends a response signal which causes a protective muscular contraction, thereby preventing the fibres from overstretching. In effect, thespindles are also able to understand whether the stretch is static or dynamic.

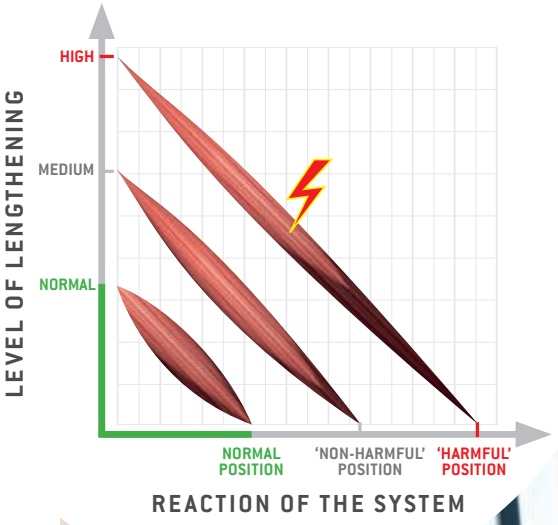
In this latter case, they also detect the rate of the stretch and, if it is deemed to be excessive - even if there is no instantaneous overstretch - they also produce a reflex contraction.

Therefore, the main aim of



stretching is to hold the joint in a position which extends the muscular-connective system beyond a maximum level which the body considers to be absolutely normal. Therefore in this extended state, a reflex contraction of the stretched muscle is generated. However, if the stretch is sufficiently tolerated by the system and the position is held for a suitable length of time, the spindle system adapts and accepts it as a 'non-harmful' position. This adaptation reduces the reflex contraction of the muscle which, by relaxing, can be stretched further.

At the same time, connective structures which have become stiff due to a lack of flexibility may regain their elasticity and increase in length.



1.4 Different techniques for improving flexibility

There are numerous techniques which help to improve flexibility.The most common techniques used for improving flexibility are: static stretching, dynamic stretching and PNF (proprioceptive neuromuscular facilitation) stretching.

• Static Stretching

Static stretching involves slowly and gradually assuming a stretching position in a controlled manner until a tolerable, but painless muscle tension is achieved.

The optimal time required for holding a stretching position varies from subject to subject and also depends of their fitness and specific preparation. In any event, it must be long enough to allow for the functional adaptation of the spindle system.

The duration of the stretching position must, however, be progressively increased in order to improve both stretching efficiency and long-term sustainability. If 15 seconds can be considered a suitable minimum duration for a subject with very poor flexibility, this duration should rapidly be increased to a minute and eventually several minutes. In this way, the neuromuscular spindles gradually adapt to the imposed tension and after a while disable the reflex circuit, instead allowing the muscle to relax.

• Dynamic stretching

Dynamic stretching involves to and fro movements, twists or swings of increasing range and intensity as far as the limits of the subject's ROM. This technique involves performing muscle stretches of greater intensity but shorter duration in comparison to static stretching. In this way, the dynamic components of the neuromuscular spindles are stimulated even further. However, controlled movements can cause both the connective structures and the muscle fibres themselves to overstretch. This is a potentially dangerous technique and must be used only by athletes and experts who are aware of their body's physical limits.

Fuethermore, if practiced appropriately, this technique helps prepare muscle tissues for the high-intensity stretching which is typical of many sports activities (Woolstenhulme et al., 2006).

• Proprioceptive Neuromuscular Facilitation (PNF)

Another possible method of muscular stretching is the PNF technique, which was originally developed for the purposes of physiotherapy (Kabat et al., 1961; Knott et al., 1968). This technique is complex and consists of various strategies, each aimed at achieving a specific result. However, the aspect most commonly utilised in fitness and wellness is the contract-relax technique.

The contract-relax technique is based both on the inverse stretch reflex produced by the Golgi tendon organs, and on the reciprocal inhibition reflex, according to which the contraction of a muscle results in the relaxation of its antagonist.

The technique consists of four phases and generally requires the assistance of a partner:

- passive stretch of the designated muscle
- isometric contraction of the antagonist muscle which cor responds to the designated muscle
- muscle relaxation
- intensified passive stretch

The sequence may be repeated multiple times.

Although there is no doubt as to the advantages of this technique, its relative complexity and the fact that it requires a partner mean that it is not a widely used technique for improving flexibility.

2.0 Multiple muscle stretching

2.1 Multi-joint muscles

Many muscles of the body insert into non-contiguous bone segments, or attach to more than one joint. Owing to the position of their insertion points, they therefore move several joints when engaged. Examples of this type of muscle include the rectus femoris muscle and the muscles attached to the spine. The rectus femoris inserts from the pelvis into the tibia and therefore moves both the hip joint and the knee joint; the muscles of the spine, which act on several vertebrae, control the flexion/extension of several tracts of the spinal column.

By the same token, stretching these muscles therefore requires the reciprocal movement of two or more joints.

2.2 Muscular concatenations

Although muscles appear to be distinct structures which are independent from each other, some of their functions are interlinked, such that nowadays increasing reference is made to mechanical concatenations of the muscular system, or 'muscle chains'.

When one thinks of a muscle, generally one imagines the muscle itself and its two related tendons: the tendon of origin and an inserting tendon. If we were stop at this anatomical representation, it would be impossible to introduce the concept of 'muscle chains'. The concept instead becomes clearer if we analyse the role of connective tissue in the human body. Connective tissue is closely linked to muscle tissue, even if the two are different from a histological point

of view.

In fact, connective tissue in the muscle is not limited to tendons; it is also present in the form of the sheath which envelopes the entire muscle (aponeuroses), the innermost sheaths (epimisium, perimisium, endomisium) and part of the muscle fibre itself. If we consider the muscular concatenation system by also taking into account the quantity and distribution of connective tissue, we obtain a much more complete picture.

Furthermore, many muscle fibres insert directly into the muscular aponeuroses (fascia), which continue with the paratenonium (sheath covering the tendons) or the fascia of a contiguous muscle.

This is why it is possible to refer to muscle chains: the aponeurotic fascia of a muscle connects with the fascia of the tendon (paratenonium) and this, in turn, connects with the sheath of the bone (periostium).

In literature, muscle chains were considered by various authors who proposed models for the purpose of representing them.

Some of the most important authors and their muscle chain classifications are presented below.

Dudal model (1982)

This model draws on the concepts reported by Struyf-Denis (1982) and describes 5 bilateral muscle chains:

1) *Posterolateral*
2) *Posteromedial*
3) *Anterolateral*
4) *Anteromedial*
5) *Anteroposterior-posteroanterior sagittals*

Myers Model (2001)

In this model chains are divided into:

1) *Posterior-superficial*
2) *Anterior-superficial*
3) *Anterior-deep*
4) *Lateral*
5) *Spiral*
6) *Brachial*
7) *Functional*

Bousquet model (1994)

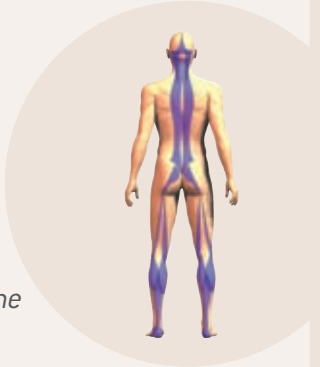
Further exploring a concept already documented by Piret and Bezieres (1976), this model subdivides the chains into a series of muscular-connective concatenations. It considers the chains of the trunk to be separate from those of the lower extremity, only for academic purposes (Busquet 1996). According to the author, it is difficult to assign a term to these concatenations according to a single logic, since certain chains are identified by their function and others by their spatial arrangement:

1) *Lateral static chain*
2) *Posterior static-dynamic chain*
3) *Anterior static-dynamic chain*
4) *Flexion chain*
5) *Extension chain*
6) *Posterior spiral chain*
7) *Anterior spiral chain*
8) *Lateral inclination chain*

Examples of muscle chains:

Posterior superficial chain according to Myers:

- *Plantar fascia*
- *Short flexors of the toes*
- *Calcaneus*
- *Gastrocnemius/Achilles tendons*
- *Femoral condyles*
- *Thigh muscles*
- *Ischiatic tuberosity*
- *Sacrum*
- *Sacrolumbar fascia/spine extensors*
- *Occipitals*
- *Aponeurotic galea (fascial scalp)*
- *Glabella*



Anterior static-dynamic chain according to Busquet:

- *Plantar fascia*
- *Interosseal muscles*
- *Triceps*
- *Quadriceps*
- *Iliopsoas*
- *Psoas minor*
- *Tensor-sartorius*
- *Rectus abdominis*
- *Intercostals*
- *Sternocleidomastoid*
- *Lower and upper hyoid muscles*
- *Masseter*
- *Temporal muscle*

2.3 Stretching of multi-joint muscles and muscle concatenations

As described above, the three most common stretching techniques are: static, dynamic and PNF. All these techniques activate certain receptors present in the skeletal muscles (neuromuscular spindles, Golgi tendon organs) which trigger a number of reflexes (stretching reflex, inverse myotatic reflex, reciprocal innervation reflex). These receptors and reflexes are also activated when another category of stretching exercises are used. Furthermore, due to the type of positions assumed, these exercises engage multi-joint muscles and series of muscles chains rather than individual single-joint muscle segments in isolation.

In order to generate useful tension in a multi-joint muscle, it is necessary to engage all the joints connected with it. In the case of muscle concatenations, all the muscles of the 'chain' are put under tension at the same time.

The muscle chain can be stretched passively simply by assuming certain positions, or actively by putting certain muscles under tension (typically the antagonistic muscles corresponding to the stretched musculature). In the latter case it is also necessary to actively control the breathing and the achievement of 'compensatory' positions. In other words, positions which the body tends to assume in order to alleviate the tension generated by stretching, by repositioning itself within a comfort zone.

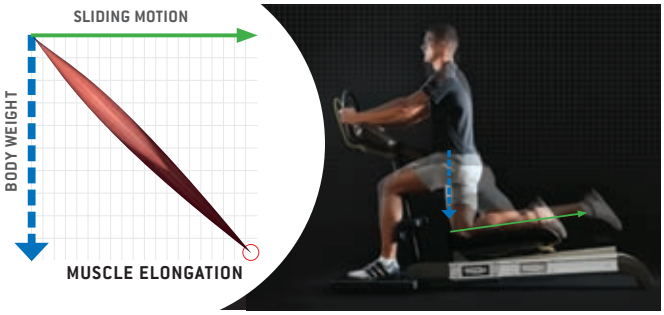
3.0 FLEXability™: a new way to work on flexibility

3.1 The FLEXability™ Method

The FLEXability™ project stems from an idea for the development of an equipment line which provides an effective, easy, safe and motivating way to work on flexibility. The equipment has been designed and built under the guidance of a team of orthopaedists, physiotherapists and exercise physiologists, and features a series of unique characteristics which we will proceed to look at in detail.

SELFLEX

FLEXability™ machines use the patented SELFLEX system, which makes it possible to vary the degree of muscle stretch by gradually bringing the user's body weight into play, thereby avoiding potentially dangerous contractions.



VISUAL FEEDBACK

By means of these numerical indicators it is possible to conduct quantitative tests on the subject's level of flexibility and, during the performance of the exercise, to control the level of stretch achieved. This in turn ensures safer and easier exercising.

INTEGRATED TIMER

The device makes it possible to programme the stretch, as well as to gradually and precisely increase its duration.

BODYPRINT

The padding has been designed so as to ensure the correct central positioning of bone segments and, at the same time, to guarantee optimum exercise comfort. This feature is particularly appreciated when the user holds the same positions for extended periods.

3.1 The FLEXability™ Method

To ensure stretching exercises carried out on FLEXability™ are safe and efficient, it is important to follow the instructions provided in the following manual.

ENTRY-VERIFICATION TEST

When using the equipment to conduct tests (explained in chapter 5) during the first session and at regular intervals, the subject's initial flexibility level and progress obtained can be ascertained. This makes it possible to set adequate objectives, a rate of progression and exercise procedures on a periodic basis.

PROGRESSION

To achieve a sustained improvement in muscle flexibility, it is recommended to follow a programme which takes into account certain exercise variables (listed on page 26 and 27). An appropriate progression will make it possible to achieve targets which may have seemed unachievable at the outset.

GRADUALITY

Graduality is essential to achieving constant improvement whilst avoiding risks to health. Rate of progression is logically dependent on age, initial flexibility level, fitness, personal injury history and the subject's occupation, whether sports-related or professional. An appropriate progression will lead to more rapid and pronounced improvements which subsequently become more gradual and less noticeable.

In any event, by measuring the stretch it is possible to detect even small improvements which are useful for monitoring progress.

The rate of progression must be based on sensations experienced by the subject during and after the session, as well as in the proceeding days. In the event of discomfort, the rate of progression must be slowed down or, in critical cases, halted (although it is still advisable to train with caution for a few sessions in order to maintain the previously attained level of flexibility).

Progression may relate to the following:

- DURATION of the stretching position, which will gradually increase;
- RANGE of motion of the stretch, with the same sensation produced by ever wider joint extensions;
- NUMBER OF REPETITIONS and SETS of a particular exercise;
- NUMBER of weekly SESSIONS.

1) DURATION AND ITS PROGRESSION

Achieving greater intensity in this sense essentially means increasing the time that a stretching position is held

Initial exercise duration.

The duration of the first few sessions depends on the subject's age and initial fitness level.

Generally speaking, a duration of 15 seconds per single exercise can be considered a suitable start time for all.

Increase in duration.

The duration of the stretch will obviously depend on the subject's age and initial flexibility. Whereas for elderly subjects, the time that a position is held will be increased at a slower rate of progression, whereas for athletes it may be increased more rapidly.

The initial suggested increase is 15 seconds per week for those who perform at least 3 weekly sessions. In the case of a lower number of weekly sessions, it is recommended not to increase stretching duration by more than 15 seconds per month.

Maximum duration.

The maximum advised duration is 2 minutes for elderly, inactive or injured subjects. In the case of active subjects, the maximum duration may be gradually increased to 4 minutes or more.

2) RANGE OF MOTION AND ITS PROGRESSION

The position assumed by the subject on the equipment must produce a feeling of non-painful tension, such that the subject feels able to comfortably hold it for a long time. The range of motion of the movement will initially be quite limited but as the neuromuscular-connective system adapts, greater range of motion will progressively cause the same sensation in the subject.

Therefore, in order to achieve the same perceived tension, the subject may achieve greater range of motion in the movement of the joint.

3) NUMBER OF REPETITIONS/SETS AND RELATED PROGRESSION

As with other training methods, including stretching, and particularly stretches using FLEXability™ equipment, it is possible and indeed advisable to perform an exercise several times in succession (repetitions) and after a pause of longer duration, to perform the sequence of repetitions (set) several times.

Repetitions/sets.

In the case of repetitions in monolateral mode (e.g. stretching one side of the body only), it is recommended to alternate right-side stretches with left-side stretches. Other exercises can be inserted in the pauses between one set and the next. The method of progression therefore entails an increase in the number of repetitions and/or sets in each training session.

In the beginning, it is preferable to perform a single set of one repetition, according to the times indicated above. Subsequently, within the space of several weeks, both sets and repetitions can be increased.

Increasing sets.

It is preferable to first increase the set by performing an exercise twice with a pause of at least 15 minutes in between the set, during which other types of exercise can be performed (cardiovascular, toning, etc.). In a standard workout session, a maximum of 3-5 sets is recommended.

In the event that the subject performs at least 2 weekly sessions, we advise increasing to 2 sets after the first month for inactive and elderly subjects, and after the first two weeks for active subjects. In the case of a lower number of weekly workouts, it is advisable to delay the increase even further.

Each further set should be added after a period of 2 months in the case of regular workouts.

Increasing repetitions.

After having increased the number of sets, it is advisable to increase the number of repetitions by performing the exercise several times in succession, alternating sides (if monolateral) or simply by returning to the starting position (if bilateral). It is advisable to increase to 2 repetitions after the first month in the case of inactive and elderly subjects, and after the first two weeks in the case of active subjects. Generally speaking, it is not necessary to increase the number of repetitions beyond 3, and in exceptional cases 4.

4) NUMBER OF WEEKLY STRETCHING SESSIONS AND RELATED PROGRESSION

The number of dedicated weekly stretching sessions provides a further means of regulating the intensity and progression of the workout.

As a maximum, and for healthy and active subjects, a higher number of weekly sessions will result in more visible benefits in terms of flexibility. Nevertheless, it is necessary to allow time for the anatomical structure of the muscle to adjust.

Initial sessions.

It is therefore preferable to suggest 2 weekly sessions at the outset for elderly people and particularly inactive subjects. Subjects who are already very active and sporty will already be able to perform 2 or more specific weekly sessions.

Increasing sessions.

Any further sessions must be added at intervals of at least 2 months for elderly and particularly inactive subjects, and at a distance of 1 month for others.

4.0 Exercise procedure

4.1 Posterior
4.2 Anterior

FLEXability™ consists of two pieces of equipment, Anterior and Posterior, which, by making it possible to perform stretches on a series of muscles, involve the major muscle groups of the locomotive apparatus.

By appropriately varying the positions assumed on the equipment and operating the very simple adjustment mechanisms, it is possible to perform numerous exercise variants and therefore fully exploit the versatility of FLEXability™.

4.1 Posterior

This machine acts principally on the posterior muscle groups of the spine and lower extremity/pelvic region.

Thanks to the raised leg position, the equipment is ideal for people who spend much of the day on their feet. In fact, the position adopted during exercise also facilitates venous and lymphatic return and the recovery of interstitial fluids. This can result in reduced intravascular pressure as a result of raising of the lower limbs.

Examples of exercises performed using Posterior:

1. Monolateral stretch of the hamstring
2. Monolateral stretch of the hamstring and calf muscles (gastrocnemius and soleus)
3. Bilateral stretch of the posterior muscle groups
4. Stretch of the hip rotator muscles and the gluteus medius
5. Monolateral hip mobilisation exercise

WARNING

It is good practice to inquire whether the subject suffers from specific and significant bone disorders, has undergone any recent operations, suffers from spinal disc protrusions or herniations or has ever experienced acute back pain. In these cases it is advisable to proceed with the utmost caution in setting initial positions and the rate of progression. Furthermore, in the event that the subject reveals a history of acute back pain, it is preferable to avoid bilateral exercise.

4.2 Anterior

This machine acts primarily on the front part of the body, focusing specifically on the hip flexor muscles, as well as both single-joint (iliac, psoas) and multi-joints (rectus femoris, sartorius).

Examples of exercises performed using Anterior:

1. Localised stretch of the iliopsoas muscle.
2. Localised stretch of the rectus femoris.
3. Localised stretch of the iliopsoas muscle with posterior pelvic tilt.

WARNING

It is good practice to enquire whether the subject suffers from specific and significant bone disorders, has undergone any recent operations, suffers from spinal disc protrusions or herniations or has ever experienced acute back pain. In such cases it is advisable to proceed with the utmost caution in terms of setting initial positions and the rate of progression. Furthermore, in the event that the subject reveals a history of acute or chronic back pain, it is preferable to completely avoid compensatory positions which involve the pelvis and lumbar tract. If any discomfort is felt when performing an exercise on one side only, it is possible to allow the same exercise to be performed exclusively on the pain-free side.

5.0 Tests with FLEXability™

General recommendations for the performance of tests:

- Always perform the test at the start of a training session, when the subject is in a resting state.
- The subject must not wear shoes during the test.
- The subject should wear comfortable and loose. clothing which does not impede movement in any way.

5.1 Tests with posterior

MONOLATERAL TEST

Objective: to test the flexibility of the hamstring muscles

How to perform the test:

• Bring the machine to the starting position. The subject must be seated correctly on the machine and rest one leg, fully extended, on the support cushion. The contralateral leg must be bent and the foot resting comfortably on the floor.

• Invite the subject to relax and to take three slow and deep breaths.

• Invite the subject to keep the ankle joint relaxed.

• Invite the subject to keep the hip joint in a neutral position (avoiding external rotation).

• Invite the subject to release the brake handle and to let the lower limb be raised slowly, whilst carefully ensuring that the pelvis does not rotate and that the sacrum remains in continual contact with the padding. The upward movement of the upper limb may be facilitated by operating the rudder.

• The subject must stop when, whilst maintaining a correct position, he or she starts to feel a bearable but painless tension, regardless of where it occurs.

• Record the value displayed on the numerical scale

• To return to the starting position, the subject must keep the brake handle released whilst lightly pushing downwards with the lower limb rested on the cushion. The movement may be facilitated by rotating the rudder downwards.

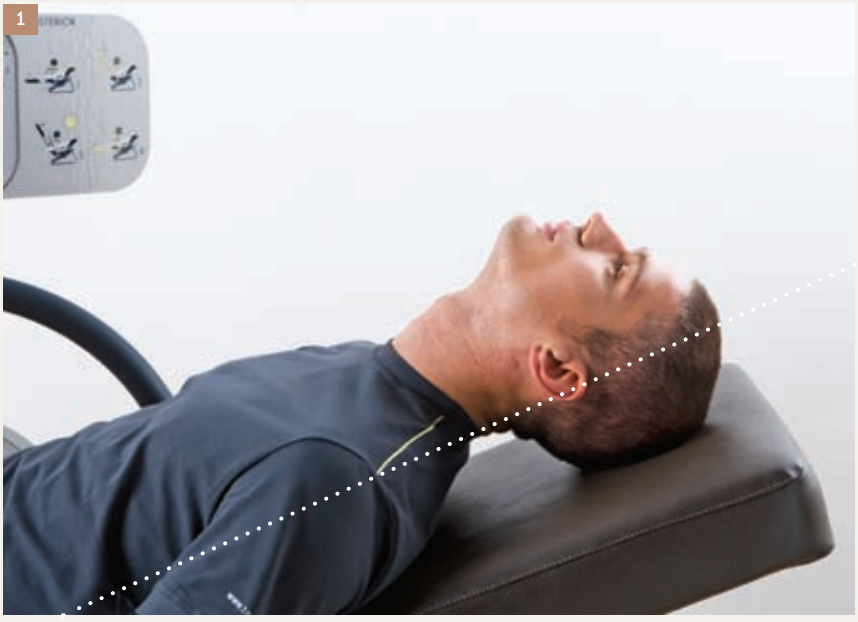
• Repeat the operation with the other side.

Check:

During the test check whether the subject hyperextends the cervical tract (figure 1), which indicates poor flexibility in the deep muscles of the dorsal-cervical region.

In this case it can be suggested that the stretch is performed with active chin retroposition (2) or, if the hyperextension may not be actively corrected, using the specially provided cushion (3).

1



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3

BILATERAL TEST

Objective: to test the flexibility of the posterior muscle groups

How to perform the test:

• Bring the machine to the starting position. The subject must be seated correctly on the machine with both legs resting, fully extended, on the support cushion.

• Invite the subject to relax and to take three slow and deep breaths.

• Invite the subject to keep the ankle joint relaxed.

• Invite the subject to ensure that the hip joint stays in a neutral position (avoiding external rotation).

• Invite the subject to release the brake handle and to let the lower limbs be raised slowly, whilst carefully ensuring that the pelvis does not rotate and that the sacrum remains in continual contact with the padding. The upward movement of the lower limbs may be facilitated by operating the rudder.

• The subject must stop when, whilst maintaining a correct position, he or she starts to feel a bearable but painless tension, regardless of where it occurs (hip extensors, lumbar region and dorsal region).

• Record the value displayed on the numerical scale.

• To return to the starting position, the subject must keep the brake handle released whilst lightly pushing downwards with the lower limb rested on the cushion. The movement may be facilitated by turning the rudder downwards.

Check:

During the test check whether the subject hyperextends the cervical tract (figure 1), which indicates poor flexibility in the deep muscles of the dorsal-cervical region.

In this case it can be suggested that the stretch is performed with active chin retroposition (2) or, if the hyperextension may not be actively corrected, using the specially provided cushion (3).

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BILATERAL TEST WITH DORSIFLEXION OF THE ANKLE

Objective: to test the flexibility of the posterior muscle groups with engagement of the calf muscles (gastrocnemius and soleus)

How to perform the test:

• Bring the machine to the starting position. The subject must be seated correctly on the machine with both legs resting, fully extended, on the support cushion.

• Invite the subject to relax and to take three slow and deep breaths.

• Have the subject perform a dorsiflexion of the ankle until it reaches a 90° angle.

• Invite the subject to ensure that the hip joint stays in a neutral position (avoiding external rotation).

• Invite the subject to release the support bar using the ankle dorsiflexion lever located on the right of the equipment and to let it drop until it comes into contact with the soles of the feet.

• Invite the subject to release the brake handle and to let the lower limbs be raised slowly, whilst carefully ensuring that the pelvis does not rotate and that the sacrum remains in continual contact with the padding. The upward movement of the lower limbs may be facilitated by operating the rudder.

• The subject must stop when, whilst maintaining a correct position, he or she starts to feel a bearable but painless tension, regardless of where it occurs (hip extensors, lumbar region and dorsal region).

• Record the value displayed on the numerical scale.

• To return to the starting position, the subject must keep the brake handle released whilst lightly pushing downwards with the lower limb rested on the cushion. The movement may be facilitated by turning the rudder downwards.

Check:
Check whether there is a significant reduction in the angle achieved when the ankle is flexed (figure 1) compared to the test performed without ankle dorsiflexion (figure 2). This indicates poor flexibility of the calf (especially the gastrocnemius muscle).
In this case, in order to stretch the calf muscles during normal exercises on Posterior, it is always preferable to use dorsiflexion, both monolateral (3) and bilateral (4).

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5.2 Tests with Anterior

STANDARD TEST

Objective: to test the flexibility of the iliopsoas muscles

How to perform the test:

• Bring the equipment to the starting position, in other words with the carriage as far forward as possible. Invite the subject to hold onto the upper handgrips and then to bring the knee forward, positioning it on the grooved cushion, with the tibia aligned along the major axis of the sliding carriage.

• Indicate to the subject the correct position of the other foot on the front platform, with the tibia perpendicular to the floor.

• The subject must hold onto the front handgrips with the arms fully extended.

• With the spinal column perfectly aligned and perpendicular to the floor, the subject may release the main lever.

• Invite the subject to relax and to take three slow and deep breaths.

• Keeping the brake lever released, the subject must let the carriage run backwards, keeping the spinal column perfectly aligned and perpendicular to the floor.

• The angle of the contralateral knee may be adjusted, whilst still keeping the foot flat on the floor.

• The subject must stop when, whilst maintaining a correct position, he or she starts to feel a bearable but painless tension, regardless of where it occurs.

• Record the value displayed on the numerical scale.

• To return to the starting position, invite the subject to release the brake handle and to gently slide the carriage forward.

• Repeat with the contralateral limb.

Check:

Check whether during the test the subject is unable to keep the spinal column aligned and adopts a swayback posture (hyperlordosis), or if he or she feels pain or any type of discomfort (1). In such cases, the foot of the front limb may be positioned on the front support (2,3). This helps to prevent anterior pelvic tilt, which in turn leads to hyperlordosis.

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TEST VARIATION

Objective: to test the flexibility of the iliopsoas and rectus femoris muscles

How to perform the test:

• Bring the equipment to the starting position, in other words with the carriage as far forward as possible. Invite the subject to hold onto the upper handgrips and then to bring the knee forward, positioning it on the grooved cushion, with the tibia aligned along the major axis of the sliding carriage.

• Raise the back of the sliding carriage to its highest position.

• Indicate to the subject the correct position of the other foot on the front platform, with the tibia perpendicular to the floor.

• The subject must hold onto the front handgrips with the arms fully extended.

• With the spinal column perfectly aligned and perpendicular to the floor, the subject may release the brake lever.

• Invite the subject to relax and to take three slow and deep breaths.

• Keeping the brake lever released, the subject must let the carriage run backwards, keeping the spinal column perfectly aligned and perpendicular to the floor.

• The angle of the contralateral knee may be adjusted, whilst still keeping the foot flat on the floor.

• The subject must stop when, whilst maintaining a correct position, he or she starts to feel a bearable but painless tension, regardless of where it occurs.

• Record the value displayed on the numerical scale

• To return to the starting position, invite the subject to release the brake handle and to gently slide the carriage forward.

• Repeat with the contralateral limb.

Check:

During the test, check whether the subject is unable to keep the spinal column aligned and adopts a swayback posture (hyperlordosis), or if he or she feels pain or any type of discomfort (1). In such cases, the foot of the front limb may be positioned on the front support (2,3). This helps to prevent anterior pelvic tilt, which in turn leads to hyperlordosis.

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