

**MICROSTRETCHING® AND STRETCH THERAPY®
ARTICLE SERIES**

Paper No. 1

Microstretching® - Revised

Nikos C. Apostolopoulos



**MICROSTRETCHING®
& STRETCH THERAPY®**

www.microstretching.com

Serapis Stretch Therapy®
& Microstretching® Clinic

1925 Garden Drive
Vancouver, BC, V5N 4W8
Canada

+ 605 255 0700

www.microstretching.com
email: microstretching@telus.net

MICROSTRETCHING® - Revised

Nikos Apostolopoulos

*Director of the Serapis Stretch Therapy® and Microstretching® Clinic
Vancouver, British Columbia, Canada, V5N 4W8*

January 2006

KEYWORDS

Inflammation,
microstretching;
microstretching
guidelines

ABSTRACT

The focus of elite sports is on intense training and elevated competition resulting in record-breaking performances all of which have exposed the athlete's body to strains and stresses exceeding its inherent adaptive capacity. An athlete's primary concern is the execution of movement—a dynamic equilibrium between structure and function. If training, skill acquisition and competition exceed the adaptive parameters of the body, the result is trauma, a sub-clinical inflammatory response directly related to the process of repair and recovery. If the magnitude of the response becomes chronic, this may develop into a physical pathological disorder. Microstretching is a soft tissue manipulation technique based on gentle stretching, both active or passive, held for 60 seconds at an intensity level equivalent to a gentle pull. The other requirement is the frequency of the stretch, being performed daily stretching each muscle group for a total of three times. The intent is to relax the nervous system thereby stimulating the body's own recuperative system, the parasympathetic nervous system. Physical trauma is an inflammatory response therefore microstretching also tries to facilitate a change in the neuroendocrine immune system through the use of a gentle mechanical force. Mechanical force influences and effects structure and ultimately function, influencing an individual's physical, mental and emotional states.

INTRODUCTION

Muscular adaptation to physical stress is significant for normal function and development. The need for proper recovery during and after training is paramount for a successful increase level of fitness. The ability to increase and/or maximize performance depends on a balance between "physical

exertion" and "recovery". If an athlete's daily training produces an imbalance between the two parameters, he/she is likely to produce symptoms of overtraining, but more importantly, will cause micro-trauma to the musculoskeletal system. The increased demands on the athlete's body to perform at higher levels may be defined as a form of musculoskeletal stress; the

pathogenesis being an increased intensity and functional load and a decrease in recovery pre-, intra-, and inter-, and post exercise and training.

The inability to recover quickly inevitably produces acute muscular symptoms such as sprains and strains; both are a direct insult on the musculoskeletal tissue. Microtraumatic responses may cause an inflammatory response. This response refers to localize damage to muscle fiber membranes and contractile elements. The inflammatory response may be a result of a single forceful mechanical event such as lifting, catching or jerking during a maximal lift or an accumulated strain associated with less forceful but repetitive loading of the musculoskeletal structure.

During exercise, two types of pain sensations are generated: *Temporary Pain (TP)* and *Delayed Onset Muscle Soreness (DOMS)*. Temporary pain is an accumulation of a metabolic byproduct (i.e. lactic acid) and fully dissipates with the proper implementation of a work/rest ratio during sets and post training. After training, a low impact aerobic activity such as walking and cycling will continue blood circulation and flush out the accumulated lactic acid.

A false assumption is that lactic acid is responsible for muscle soreness 2 or 3 days post intense workout. Blood and muscle lactate levels typically return to normal values after 30 to 60 minutes of recovery. The micro-trauma to the connective tissue is responsible for this soreness as a result of microscopic tears of the muscle tissue. The symptoms usually appear a couple of hours to a day post strenuous training, peak between 1 and 3 days and disappear within 5 to 7 days. Shepherd and Shek have suggested that strenuous muscular work can trigger the initiation of an inflammatory cascade, characterized

by a series of cellular and humoral changes qualitatively similar to, but quantitatively different from trauma and sepsis (Shepherd and Shek, 1998). Muscle damage is indicated by ultrastructural and morphological changes, as denoted by an increase and presence of intramuscular neutrophils and cytokines. The neutrophil infiltration persisted for up to 5 days (Fielding et. al. 1993). Its influx serves to clear damaged tissue in preparation for repair and cell growth, the proliferation and remodeling phases of an inflammatory response.

Recovery of the muscle tissue depends on the intensity and duration of the athlete's exercise program and the type of exercise. Eccentric exercises, a forced contraction during lengthening, causes the greatest damage to the connective tissue with extreme soreness post exercise and training. A possible explanation may be that fewer fibers are recruited to handle a given load, resulting in an excessive mechanical strain on the fibers (Clarkson, P.M. et al. 1992). Other studies have reported an increase in cytokines from high intensity long duration exercises exceeding 75% of an athlete's aerobic capacity for a duration of 2 hours (Bury, T.B. et al. 1995).

The regulatory activity of a proper recovery regeneration routine is important to correct departures from the normal course of the health of the connective tissue. Unlike severe trauma and sepsis, which can be life threatening, this sub-clinical response to trauma caused by exercise, is a removal of damaged cells with the subsequent regrowth of connective tissue as witnessed by an increase in collagen production. The disturbances affecting the function of the musculoskeletal system can be classified as either acute or chronic. An-acute response can be defined as

an equilibrium between physical exertion and recovery. The individual recovers fully and the connective tissue adapts to a new training level resulting in an increase in performance. The collagen that is deposited produces weak fibrils with random orientation. With maturity the collagen during the remodeling phase becomes oriented in line with local stresses (Doillon C et al. 1985). However, a chronic response may be interpreted as an imbalance where the process of physical exertion overrides the recovery process. The musculoskeletal system is in constant flux and is not given the opportunity to adapt to the new physical demands. It is only with proper rest and recovery that the individual will resolve this imbalance.

The athlete's response to a physical demand on their body is to adapt both quantitatively and qualitatively. The vital response is an inherent protective adaptive mechanism whose outcome is to establish a new or maintain an old level of function. Many therapeutic techniques as well as the manipulation of the training parameters (intensity, frequency and duration) have been designed to work synergistically with this adaptive mechanism. The recovery processes work to restore damaged tissue as a direct adaptation to a normal function.

MICROSTRETCHING

Microstretching is directed towards the restoration of normal structure and function. It aims to restore the integrity of the connective tissue thereby increasing its load handling capacity. It is important that a technique conforms to the recuperative process of the body. If the technique is aggressive and the musculoskeletal tissue is inflamed the individual may find him/herself in a perpetual recovery-inflammatory

phase not fully progressing and improving their performance.

Ippolito has suggested that for the proper function of the musculoskeletal system there needs to be a constant ratio between the force of muscular contraction and resistance of the tendon (Ippolito et al. 1986). The musculo-tendinous unit can be considered the interface of adaptation to different locomotor needs. This is very important in cushioning abrupt and violent motor stimuli (ibid). Conditions such as muscle fatigue and weakness diminish the contractile ability of the muscle predisposing the musculo-tendon unit to a strain injury (ibid). In accordance to Ippolito microstretching takes into consideration the adaptive interface of the myotendon junction and the stresses that affect it.

The relative tensile strengths of the connective tissues of the myotendon junction, muscle and tendon, provide clues as to the intensity of the stretching exercises. Muscle has a tensile strength of 77 lbs/in² (5.41 kg/cm²) while tendons have a tensile strength of 8700 to 18000lbs/in² (604.64 to 1264.53 kg/cm²) (Hollinshead et al 1981). At the muscle laboratory of Duke University researches found that cyclic stretching equivalent to 50% of the maximal force needed to produce failure resulted in a significant increase in the length of muscle stretched to failure (Laszlo, J et al. 1997). Even though the study was conducted on animals it indicated the importance of light intensity stretching and its ability to increase length and decrease the likelihood of injury to muscle.

The dynamic forces (tension, compression, shearing, rotation and bending) and how the structure functions under these forces, ultimately determines the reaction of the connective tissue. These forces

are present during training, directing and controlling the response of the musculo-skeletal system. The response of the body to the effect of these dynamic forces can be lessened with the use of microstretching. Microstretching helps recovery of the traumatized tissue by aiding the recuperative powers of the body. This restoration helps the athlete to increase their physical loads and sustain longer and harder training sessions with minimal damage to the connective tissue. This is possible for microstretching does not cause more tissue damage because of the intensity that the athlete stretches.

The athlete's primary concern is the execution of movement—a dynamic equilibrium between structure and function. The technique of microstretching provides simple guidelines effective for increasing performance decreasing the potential of tissue damage. During the recovery an athlete needs to incorporate a proper recovery-regeneration program aiding them in tissue regeneration.

The key to a proper recovery program takes into consideration the intensity, frequency and duration of the stretch. The intent is to diminish any inflammation therefore, it makes no sense to introduce a recovery technique that causes pain which in turn has the potential of causing muscle fatigue and weakness. As indicated earlier by Ippolito a violent motor stimuli (i.e. an aggressive stretch) has the potential of causing more damage to the musculo-tendon junction.

The belief behind microstretching is that a proper stretching program, should enhance the integrity of the connective tissue, not cause tissue damage. The use of gentle passive stretching is believed to increase the recovery process and at the same time develop a "flexibility reserve". This

reserve refers to the development and storage of an increased range of motion thereby enhancing performance, allowing movement to be executed without excessive tension. This decreases the resistance of the extended muscles and serves as a means of diminishing the potential of injury.

Microstretching may exceed other forms of flexibility (ballistic, active assisted and proprioceptive neuromuscular facilitation) with regards to recovery. It does not believe in creating pain or tissue discomfort in order to help the tissue recover and increase range. The decrease in muscle tension may result in an increase in circulation and neural conductivity to the muscles. Dr. Robert Salter, the developer of Continuous Passive Motion (CPM), has shown the importance of passive motion as a therapeutic modality following trauma to the connective tissue. Salter hypothesized that a gentle passive motion technique would accelerate the healing of articular and peri-articular structures, such as the joint capsule, ligaments and tendons (Salter 1989). Even though his emphasis was post-operative patient care the effects of trauma and inflammation can become inhibitors to rehabilitation. Early passive non-painful recovery can assist connective tissue to heal in an acceptable manner, resulting in the typical parallel arrangement of collagen and elastin fibers (ibid).

The emphasis in this section has been to establish the positive influence of gentle forces on the recovery of the musculoskeletal tissue. The implementation of this knowledge and how it may influence the training parameters (intensity, frequency and duration) provides the athlete and the coach with tools to develop a proper recovery program aimed at preventing injury but more importantly increase

the performance and longevity of participation of the athlete.

Intensity

Microstretching is always executed at a low intensity level (approximately 30-40 percent of a maximal perceived stretch). This value was based on anecdotal evidence amassed at the clinic and further supported by the study at the Duke University Muscle lab. In fact this value was less than the value obtained at the lab as indicated above. This intensity level is believed to increase the pliancy of the connective tissue, specifically the myo-tendon junction.

Similar to micro-injuries the influence of microstretching is manifested at the cellular level. Unlike a strain, microstretching results in a minimal activation of the specialized receptor tissues of the muscle and tendon (the muscle spindle fiber and the Golgi tendon organ). The muscle spindle senses muscle lengthening while the Golgi tendon organ senses tension.

Microstretching may aid in the realignment and potential breakdown of scar tissue. As scar tissue is laid down the ability to help it align according to the direction of stress is paramount in organizing the tissue in parallel strands. The gentle passive force generated during microstretching may support this view as explained earlier with regards to Dr. Salter's work. Otherwise, there is a tendency of scar tissue to be deposited in a chaotic manner with no order. As scar tissue ages, there is a tendency for compression to occur predisposing the injured area to a greater level of strain. If an athlete partakes in an aggressive form of stretching this may be responsible for causing micro-tears initiating the development of scar tissue. Therefore it is critical while stretching to avoid the sensation of pain. This will activate the

sympathetic nervous system thereby increasing muscle tone predisposing the connective tissue to greater stress and strains. This increase in tone may be responsible for an inflammatory response for the tissue is more likely to be traumatized. This type of insult on the tissue if repeated over many times may perpetuate a recovery-inflammation loop, reinforcing and maintaining an injured state.

Frequency

Tudor Bompa in, "Periodization" (Bompa, 1999), suggests in order for athletes to improve their flexibility they need to stretch at least twice per day, in addition, each muscle group needs to be stretched at least three times per session. Repetition is vitally important. Learning movements and improvement of skills, both in infancy and adulthood, are dependent upon repetition. Repeated stimulation of the central nervous system integrates the new physical pattern, turning it into an automatic response.

The ongoing development of flexibility increases the sensitivity of the proprioceptive tissues. This aids in the processing of information, enabling the athlete to sense the significance of a physical stimulus and in turn affect a suitable motor response.

The habitual development of flexibility and the increase in muscle length will enable the athlete to recover faster post workout. DeVries, in his electromyography study, indicated the delay in the onset of muscle fatigue (DeVries and Adams 1972), and the prevention and alleviation of muscle soreness after exercise (DeVries 1961). With an increase in the functional range of motion there is a reduction in the incidence and severity of injury (Taylor et al. 1990).

Duration

A recent physiotherapy study in the United States, looking at the effect of duration of stretching of the hamstring muscle in an elderly population, concluded that the optimal length to hold a stretch is approximately 60 seconds. This 60 second passive stretch produced the greatest increase in rate of gains with respect to range of motion (ROM). At the conclusion of the three month study, the group introduced to a 60 second stretch had an increase in degree gains of 2.4 degrees per week as compared to a 30 second stretch and a 15 second stretch whose gains were 1.3 and 0.6 degrees per week respectively (Feland J B et al. 2001).

At the microstretching clinic, clinical observation indicated that a stretch held greater than 60 seconds resulted in patients feeling tighter. The Golgi tendon organ may be responsible for this phenomenon. Prolonged, low intensity stretching of a muscle may cause the muscle to lengthen slightly beyond its normal resting length. Even though the intensity of the stretch was low, dampening the stretch reflex, the sensation of tension though light was still registered by the proprioceptive tissues, particularly the Golgi tendon organ. The low intensity stretch was sufficient enough to have a direct effect on the connective tissue causing an increase in tightness.

Sequential changes in the function of muscle will affect performance. A defining quality of an athlete is the maturation and coordination of the musculoskeletal system, particularly the maturation of the neuromuscular system. As suggested by McGraw, specific behavior and physical functions are associated with definite anatomical structures of the nervous system (McGraw 1989). During recovery, there is an important need to place the body in a position

conducive to relaxing the nervous system eliminating the potential of a muscle contraction. This state refers to the principle of Stability Balance and Control (SBC®).

Trauma to the musculoskeletal system may stimulate the sympathetic nervous system (SNS) and its subsequent response. This is not independent of sympathetic function (Blumberg H et al. 1997). It is important to relax the nervous system for the constant activation of the SNS may lead to clinical conditions defined as sympathetically maintained pain (SMP) (ibid). Sympathetically maintained pain may be responsible for the development and maintenance of chronic pain experienced by athletes. This pain is exemplified by a response termed protective adaptation (PA), the adjustment of the musculoskeletal system to diminish and prevent the sensation of pain. Protective adaptation may develop over many years of exposing the body to trauma and intense training without proper recovery. Protective adaptation may result in an extensive decrease of the range of motion about a joint(s). This decrease may account for a change in the movement behavior of the body restricting the ability of the muscle to accelerate through a full ROM. This restriction may ultimately result in a decrease in athletic performance and longevity within the athlete's sport of choice.

APPLICATION OF MICROSTRETCHING

Lack of flexibility hampers the development of motor skills. The increase of speed is adversely affected since the athletes will accelerate their limbs over too short of a distance. Insufficient flexibility affects the motor efficiency of endurance sports. This decrease in range of motion translates

into an increased effort requiring greater energy.

The natural ability to increase performance is through the proper implementation of a -recovery-regeneration program. This will ensure a synchronized nerve-muscle connection. The modulated neuron will in turn effect and determine new structural and/or functional relations defining and in turn being defined by a new muscle patterns being both flexible and dynamic with a high degree of structural; order.

Repetition is the means by which the athlete learns the patterns specific to their sport. If an athlete has had an injury or a growth spurt and stretching exercises are not prescribed specifically to increase range of motion about the joint(s) this will result in an altered pattern of muscle use affecting proper skill acquisition. The successful handling of the training and treatment of an injury will impart a conviction to the athlete to continue flexibility training.

Flexibility develops a natural continuity of exercises, a rhythmical function of the main muscle groups, as well as the ease of regulating the loads of training (intensity, volume and frequency). Coordination is fully enhanced and developed though the proper development of flexibility. The athlete's coordination is determined by the repertoire of skills.

When training for either explosive or endurance event the use of microstretching is the same. The changes imposed on the function of the musculoskeletal system are a derivative of a developmental structural change. For instance if the angle of the joint is altered as a result of an injury or repetitive strain, this will impede the proper acquisition of a movement pattern. The athlete will never truly attain maximal

performance for the musculoskeletal system has been altered changing its function. Flexibility training helps to address this adaptive physical response resulting in an efficiency of movement.

A true state of the musculoskeletal system is a "cold state". This refers to connective tissue whose core temperature has not been increased due to a warm up or during and after physical activity. The information relayed to the central nervous system of the "cold state" is essential in perceiving the slightest strain or pain in the connective tissue. This acts as a prophylactic mechanism warning the athlete to spend extra time on the muscle. If such a step is neglected the outcome could be catastrophic.

The application of stretches following the guidelines of microstretching offers several advantages to athletes, circumventing the limitations imposed on stretching routines of the past. Many athletes will be able to readjust the biological adjustments of the musculoskeletal systems introduced and designed to protect the connective tissue. This will help to re-establish proper locomotor mechanics. Greater compliance of the muscles, tendons and ligaments will ensure the athlete to perform with maximal force and acceleration.

Microstretching was developed to increase the range motion about a joint and to address the increase of inflammation due to training and injury. It is not prescribed as a pre-warm up stretch routine, dynamic flexibility will suffice for it will aide in the preparation of the connective tissue. Upon cessation of training it is important to allow the body to cool down. Therefore microstretching is recommended two hours post. It is more important to remove as much lactic acid as possible prior to stretching. When the body has fully

cooled down, one gets a better indication of how tight they are and are more likely to allocate the appropriate time for stretching. This will prevent injury and the potential for the development of chronic musculoskeletal disorder.

In summary, the increase in flexibility as a result of microstretching is beneficial to the development of the athlete. The increase in range of motion is the common denominator with the specific demands of the sport determining its use.

CONCLUSION

The musculoskeletal system and the behavior correlated with its function and development are a complex and dynamic organization. When the training is intense the tendency is for the connective tissue to be traumatized resulting in an injury. The effectiveness of the body is measured in its ability to overcome this trauma, repairing itself and adapting to a new level of training. This unique evolution is enhanced by the implementation of a proper recovery-regeneration program designed to accelerate the healing process in between training. Unlike conventional methods that produce pain, microstretching is relevant to the healing process by depressing the response of the sympathetic nervous system and dampening the muscle spindles and Golgi tendon organ ameliorating the inflammatory response. Clinical experience attained at the Serapis Stretch Therapy Clinic, has resulted in the development of the microstretching guidelines. These guidelines result in the athlete's ability to train at greater loads and volume increasing their performance level.

REFERENCES

- Blumberg, H., Hoffmann, U., Mohadjer, M., Scheremet, R., 1997. Sympathetic nervous system and pain: A clinical reappraisal. *Behav. Brain Sci.* **20(3)**: 426-434
- Bompa, T., 1999. Flexibility Training. In: *Periodization, Theory and Methodology of Training 4th edition*. Champaign: Human Kinetics, pp. 375-379
- Bury, T.B., Louis, R., Radermecker, M.F., and Pirnay, F. 1995. Blood mononuclear cells mobilization and cytokines secretion during prolonged exercises. *Int. J. Sports Med.* **17**: 156-160.
- Clarkson, P.M. et al. 1992. Muscle function after exercise-induced muscle damage and rapid adaptation. *Med. Sci. Sports Exercise.* **24**: 512-520.
- Devries, H.A., & Adams, G.M., 1972. EMG comparison of single doses and meprobamate as to effects of muscular relaxation. *Am. J. Phys. Med.* **51**: 130-141
- DeVries, H. A., 1961. Electromyographic observations of the effects of static stretching upon muscular distress. *Res. Quar.* **32**: 468-479
- Doillon C et al. 1985. Collagen fibre formation in repair tissue. Development of strength & toughness. *Coll Rel Res* **5**: 481-92
- Feland, J.B., Myrer, J. W., Schulthies, S. S., Fellingham, G. W., & Meason, G. W., 2001. The effect of duration of stretching of the hamstring muscle group for increasing range of motion in people aged 65 years or older. *Phys. Ther.* **81**: 1110-1117

Fielding, R.A., Manfredi, T.J., Ding, W., Fiatarone, M.A., Evans, W.J., and Cannon, J.G. 1993. Acute phase response in exercise III Neutrophil and IL-1 β accumulation in skeletal muscle. *Am. J. Physiol.* **265**: R166–R172

Hollinshead, W.H., Jenkins, D.B., 1981. Muscles. In: *Functional Anatomy of the Limbs and Back*. Philadelphia: W. B. Saunders, pp. 31

Ippolito E 1986. Physiology. In: Perugia L., Postacchini F., Ippolito E (eds). *The Tendons*. Milano: Editrice Curtis, pp. 47–58

László J., Pekka, K., 1997. Functional and Mechanical Behavior of Tendons. In: *Human Tendons, Anatomy, Physiology and Pathology*: Champaign: Human Kinetics, pp. 108–109

McGraw, M. B., 1989. *The Neuromuscular Maturation of the Human Infant*. London: Mac Keith Press.

Salter, R. B., 1989. The biological concept of continuous passive motion of synovial joints. The first eighteen years of basic research and its clinical implication. *Clin. Orthop.* **242**: 12–24

Shepherd, R. J. & Shek, P. N. 1998. Physical exercise as a human model of limited inflammatory response. *Cdn. J. Physiol. Pharmacol.* **76**: 589–597.

Taylor, D., Dalton, J. D., Seaber, A. V., & Garrett, W. E., 1990. Viscoelastic properties of muscle tendon units—the biomechanical effects of stretching. *Am. J. Sports Med.* **18**: 300–309