All of us have exercised regularly or been involved in some sporting activity and are undoubtedly familiar with muscle soreness. We also know that this soreness increases when we engage in an exercise activity for the first time after an extended absence, or when we repeatedly use a muscle or muscle group for an extended period without rest.

2 TYPES OF MUSCLE SORENESS

There are two types of muscle soreness we commonly experience. The first is **immediate muscle soreness** - that which we feel right after or even during the activity. This type of soreness is a result of a buildup of metabolic by-products such as lactic acid, and from a lack of oxygen in the tissue (ischemia).

The second type is **Delayed Onset Muscle Soreness or DOMS.** This is the mild to severe soreness and stiffness we experience 24 to 48 hours following our activity. The cause of DOMS is not clearly understood, however, there are three leading theories that propose an explanation for this form of muscle soreness.

Before outlining these 3 specific theories I want to note two general consensuses that almost all current theories acknowledge.

1) That eccentric action of the muscle is the primary initiator of DOMS. This is the action involving the contraction of the muscle while lengthening rather than shortening: as in the negative work lowering weights in weightlifting or running downhill.

2) Actual tissue damage and subsequent inflammation occurs contributing to the soreness of the muscles.

3 THEORIES FOR THE OCCURANCE OF DOMS

1. ISCHEMIA / SPASM CYCLE

One theory that has received support through scientific research is the idea of an **ischemic-spasm cycle,** or **sustained pain-tension cycle**. This theory proposes that during exercise, the decrease of oxygen and the build up of metabolic by- products causes pain. This pain induces the muscle to spasm slightly further reducing the oxygen available to the tissue. The further decrease in oxygen increases the amount of metabolic by-products and the vicious cycle continues.

2. DAMAGE TO THE CONNECTIVE TISSUE

A second theory is that structural damage to the connective tissue occurs. Microscopic tears occur in the connective tissue particularly as a result of eccentric contractions. This damage leads to an inflammation response. The combination of irritants in the tissue from the damaged cells and the subsequent repair response to the damaged regions (increasing lymph fluid

containing WBC's) causes inflammation, which, along with the torn tissue, is responsible for the soreness.

3. MUSCLE DAMAGE

The final and most widely accepted theories is that of injury or damage to the muscles themselves, particularly the muscle fiber, and possibly the sarcolemma (cell membrane). Studies show an increase of 2 to 10 times the normal levels of muscle enzymes present in the blood after a sequence of intense exercise, suggesting structural damage to the muscle membrane. I am passing around pictures of muscle tissue from a marathon runner post race showing the damage to the muscle fibers and cell membrane.

As with the connective tissue theory the combination of torn muscle tissue and the resulting inflammatory response are responsible for the muscle soreness. In addition it has been proposed that the products of macrophage activity and the accumulation of calcium ions, potassium ions, and other intercellular contents outside of the cells irritate the free nerve endings in the muscle.

Although widely acknowledged these theories are still just that, theories. The precise mechanism of skeletal muscle damage and repair are still not well understood.

MASSAGE AND THE ATHLETE

Massage has become a cornerstone in the training programs of many serious athletes both amateur and professional. The most common reasons for this are the strong belief in proper athletic massages' ability to 1) Enhance the recovery of muscles
2) Help in preventing muscular, tendinous and ligament injuries, and 3) Help increase athletic performance.

MUSCLE RECOVERY

Microscopic tears occur daily in the muscle tissues of an athlete due to the hard training regime that these athletes subject themselves to. Deep massage will both increase blood circulation (hyperemia), and increase the movement of lymph fluid through the muscle tissue. The two effects here are to milk metabolic waste products from the tissue and to move fresh, oxygenated blood into the tissue, both improve muscle recovery. Removing metabolic by-products via the lymph system
decreases Delayed Onset Muscle Soreness and reduces fatigue of the muscle. The fresh blood brought to the tissue carries nutrients that may speed the repair process of the muscle fibers.

INJURY PREVENTION

The beginning athlete is prone to muscular and tendinous injuries due to the fact that the force being applied to these tissues is often greater than their inherent strength. With conditioned athletes training has thickened the muscles, tendons and ligaments and therefore these athletes tend to suffer fatigue related injuries rather than the tearing of unconditioned structures.

Muscle fibers work in unison and when several fibers become rendered useless, through adhesion or becoming stuck in contraction, the overall strength of the muscle is diminished. In addition, the excessive load on muscle tissue common in athletic performance can lead to the

injury of that muscle if all fibers are not working or injury can occur to one of the synergistic muscles that have to pick up the slack.

Deep massage, especially cross friction massage to both the muscle bellies and the tendinous attachments rolls and stretches the muscles and breaks up adhesions between muscle fibers. This allows the fibers to act freely and gives them back the ability to relax and take part in normal contracture upon demand. With full muscle function chances of injury decrease.

ENHANCED ATHLETIC PERFORMANCE

To compete at its highest potential the human body must be able to flow uninhibited through any motion the athlete's sport requires. Any inhibition to movement can decrease performance.

The freeing up of the muscle fibers described in injury prevention also correlates to increased performance. It only stands to reason that if we can access all the fibers of a muscle then we get everything that muscle can offer.

In addition to loosening fibers massage also lengthens muscles shortened by the frequent contractions an athlete asks his muscles to perform. Returning the muscles to the optimum length restores lost mobility and ensures optimum power and fluidity.

CONCLUSION

The more we study and begin to understand the mechanisms of muscular breakdown and repair, and the more in-depth our understanding of massage and its effects on our musculature and the human body systems in general the more athletes will turn to massage as an integral part of training. As it stands now, we know that massage; stimulates circulation, increases lymphatic flow, breaks up undesirable adhesions and fibrosis, relaxes muscle spasm, reduces swelling and relieves pain. All of these effects contribute to muscle recovery, injury prevention and increased performance!

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