Understand the Complex Relationship Between the Muscles, Ligaments and Connective Tissue with FLX

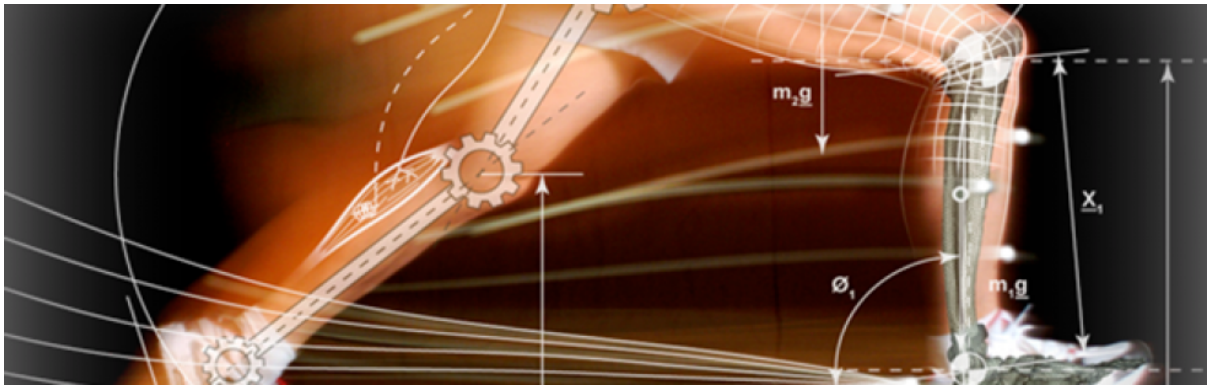
Keep Your Employees Fit and Active

Understanding the role of muscles

The relationship between the different soft tissues of the body, including muscles, ligaments and fascia (connective tissue that binds everything together), is a highly complex biomechanical chain of events.

It is crucial to understand the fundamentals of how they work to be able to prescribe exercise programmes for individuals who are active or perform physical tasks during their working day and even for those who are sedentary and are often seated throughout their day in the office or traveling. It is also important for those who are active in their spare time.

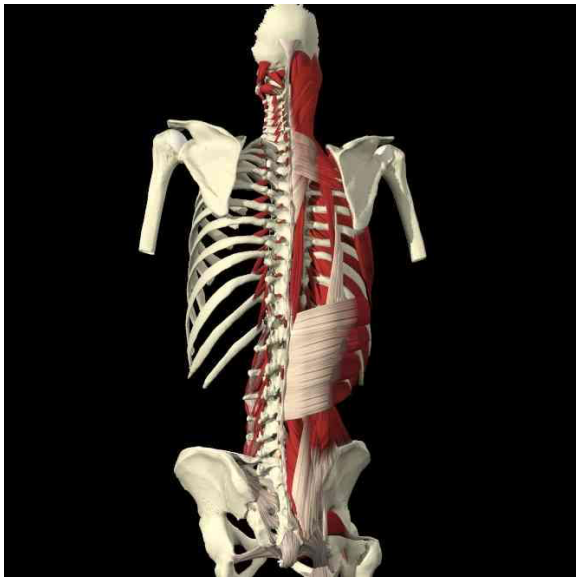
Some of the joints of the human body are linked together in such a way that motion of the joints in the series is accompanied by motion at an adjacent joint. This type of motion can be described as a kinetic chain. Kinetic chains, in the engineering sense, are composed of a series of rigid links that are interconnected by a series of pin-centred joints. In engineering, the system of joints and links is constructed so that motion of one link at one joint will produce motion at all the other joints in the system in a predictable manner. In the human system of joints and links, the same principles can be applied, so when you bend your knees to pick up an object, your ankles and hips automatically bend in synchrony.



Exercise helps to optimise how the body functions. Emphasis on the functional role of muscles in maintaining dynamic joint stability is necessary to perform coordinated and natural movements. This functional role views muscles as working together in these chains to perform functional activities rather than as individual muscles having the classical roles expressed as their actions, as seen in anatomy books. This complex interaction means that, while muscles can respond to different traumas, overloads or injuries, it can lead to compromised performance and repeated overload may lead to an increase in pain. Muscles can become overactive and appear shorter or conversely, they can become inhibited and weakened. For example, if a muscle is subjected to unaccustomed activity, in the case of over activity for a prolonged period, it aches, sometimes for several days. This phenomenon may not manifest itself until the day after the unaccustomed activity. This is called Delayed Onset Muscle Soreness, (DOMS). While there are different theories, DOMS is generally associated with increase in muscle tone and faulty excitation of muscle. This phenomenon is termed "The Calcium Paradox". The cause is thought to be related to a fatiguing muscle placing strain on microelements of the muscle causing a localised

inflammatory response. If the mechanical integrity of the microelements is compromised, then the muscle is no longer able to contract and relax properly i.e. it cannot relax and is 'upregulated'. The upregulation will be perceived as a tightening of the muscle and the continued upregulation can place greater stress on the microelements causing further mechanical stress and a fatigue induced muscle soreness.

In a normal individual this chronic state is avoided because we naturally



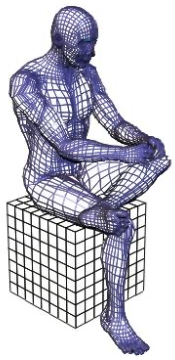
move giving the muscle a normal input and allowing it to relax. If, however, we ignore the warning signs the continual irritation of the now pre-fatigued muscle leads to physical changes within the muscle. Up to 40% of muscle fibres can be replaced by connective tissue (almost like a ligament that does not contract or relax). Once this occurs, normal mechanics are no longer possible without appropriate management.

A shortened muscle will restrict joint and nerve movement, compromising how they work. Typically, the opposing muscle will become inhibited, which presents as a muscle imbalance. The change in muscle capacity may also lead to abnormal mechanical load being placed on any joint the affected muscle crosses and place altered biomechanical stresses on other areas of the body.

The way the nervous system reacts to these different stimuli will influence the biomechanical presentation, and therefore how to how to effectively improve the situation. Commonly, the systems reaction to any of the above stimuli will result in a muscle imbalance somewhere along the biomechanical linkage system or kinetic chain. Current thinking suggests a link between an injury and its biomechanical source. This must be addressed to prevent a recurrence of the injury.

It is difficult to define weakness of muscle, what does weak mean? Commonly, a muscle can be inhibited or perform sub-optimally, but there is little in literature that defines a weak muscle. The best that can be defined, at present, is an inhibition of the motor neuron making it unable to continue the propagation of the nerve impulse to cause the chemical changes that engage a muscle to contract. However, the control of muscles and the body's ability to stimulate muscles at the right time to enable it to perform smooth, co-ordinated movement is of paramount importance for control and maximizing function.

Conducting sub-maximal, prolonged contractions has been shown to be effective in reducing the effects of upregulation within a muscle and therefore allowing the restoration of optimal muscle function. This down-regulation phenomena is described by Jiri Dorvak, Professor of Neurology and former Chief Medical Officer for FIFA. He established that a muscle relaxes (downregulates) maximally



after it has been contracted sub-maximally and for a prolonged period. He refers to it as 'Post Contraction Sensory Discharge'. More work has been carried out by Ribot-Ciscar and colleagues, where they looked at the activities of human muscle spindle primary endings in the lateral peroneal nerve using the microneurographic method. The aim of that study was to test whether voluntary isometric contraction causes any after-effects, first in the resting discharge of muscle spindle primary endings and secondly in their responses to a slow ramp stretch. To investigate the latter point, the initial angular position of the ankle was passively adjusted until the unit fell silent, in order to introduce a delay in the responses to muscle stretch. They found that isometric voluntary contraction led to changes in muscle spindle stretch sensitivity, which resulted in a reduction in the stretch threshold and a decrease in the muscle spindle dynamic sensitivity.

This data suggests that the after-effects observed may have been triggered by static fusimotor neurones. The results are discussed with reference to the theory according to which the processing by the CNS of muscular proprioceptive messages deals mainly with signals arising from muscles stretched during movement, and it is concluded that the coactivation of x and y motor neurones, during the contraction, facilitates the coding of the parameters of forthcoming stretching movements, by the muscle spindles. So, in other words, the 'muscle release' or downregulation exercises allow the muscle to stretch better after the 'contraction', and consequently improves the function of the muscle.

Relevance

The capacity of a muscle to perform, both statically and dynamically, is essential for the efficient running of the movement system. Any up or down-regulation of one muscle or muscle group can affect the performance of the whole. Local or global muscle fatigue due to poor capacity can compromise the body's ability to tolerate loads and so lead to injury.

As it is difficult to accurately define 'strength' in this context, we refer to exercises that would typically purport to increase strength as muscle performance exercises. In other words, they are designed to improve the functional performance of the group and associated structures in the kinetic chain.

The FLX app uses specific screening and exercise interventions to affect the upregulated muscle to improve its capacity to perform more naturally.

This is a part of the intrinsic biomechanics model used by FLX, which has been shown to reduce absenteeism due to MSD.

Martin Haines

Chief Medical Officer | FLX Health