Basic Principles of Biomechanics Part 2

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Kinematic chains. This is a biomechanical term used for a series of rigid links that are interconnected by joints, which allow the limb to move in a predictable manner. It can either be an open kinematic chain or a closed kinematic chain. In an open kinematic chain, one joint is able to move independently to the proximal joints and has the freedom to move through space. In a closed kinematic chain, the distal end of the limb is fixed, but the segments are able to move. There is no net change in limb position, but the movement has occurred. For example, when standing and shifting off balance, yet you have not moved from your original position.

In order to understand gross muscle contraction, we need to understand the concept of muscle length-tension relationships. In this diagram, we can see the relative link between the length of muscle tissue and the ability to contract as muscle contractile tissue. We have an optimal zone, which is needed for maximal actin and myosin interaction. If the actin and myosin are packed too closely together, the sarcomere is unable to contract, as there is a restriction of space. Therefore, the sarcomere is rendered useless.
If the actin and myosin are separated too far apart, there is no ability for the calcium to create the polar bond and linkage. And therefore, there is no contraction, as there is no linkage between actin and myosin.

Active and passive inhibition. These are two biomechanical concepts that describe the behaviour of muscle when set in anatomical fields. Active inhibition is where the muscle contracts to the point where it cannot move the limb any further due to soft tissue obstruction. The muscle is still able to generate a contraction but is unable to move further.

In passive inhibition, the muscle cannot contract eccentrically, as the limb is stretched beyond the anatomical limits of the sarcomere. The muscle is unable to initiate contraction unless the length is reduced. Muscle physiology and biomechanics. The muscles are our powerhouses and our movers of the body. Because of this, they tend to fatigue easily and can potentially get injured. By looking at the behaviour of muscle in contraction, we are able to determine when a muscle is injured, or underperforming due to altered mechanics and general muscle pain syndromes such as delayed onset muscle soreness.

Muscle testing is a simple and effective method of assessing muscle behaviour and potential injury. The factors that affect muscle strength are motor-unit summation and increased rate coding. In motor-unit summation, the more motor units the muscle uses to contract, the more summative contraction can be achieved. We see this in explosive forceful contractions such as that in sprinting.
In increased rate coding, increasing the rate of fire of each specific motor unit increases the total rate of recovery and re-contraction of the muscle. This is seen in the gradual buildup of muscle contraction, such as applying weight in weightlifting.

The factors affecting muscle tension are primarily dictated by the number of muscle fibres in that unit, and the size of the fibres i.e. the larger the fibres, the more tension that can be generated specific tension per cross-sectional area i.e. the smaller slow twitch fibres generate approximately 1.73 kilograms of tension per square centimetre. And larger fast twitch fibres generate about 2.23 kilograms of tension per square centimetre.