Yang Chengfu's Ten Essentials insured that the practice of Tai Chi Chuan would improve people's health. It is impossible to overstate the importance of these Ten Essentials in identifying the elements that make Tai Chi Chuan a healthful practice. Without the Ten Essentials, it is doubtful that Tai Chi Chuan would be recognized all over the world as a unique exercise system that offers special benefits to those who practice it.

LOOKING THROUGH THE LENS OF SCIENCE AT THE TEN ESSENTIALS OF TAI CHI CHUAN

PART 5

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PART V

A Brief Review

So far in our series, we have looked at three of the 10 Essentials and introduced several key concepts from the science of biomechanics. It is important to keep these concepts in mind as we continue on our exploration of the 10 Essentials. Here's what we have learned so far:

The smallest functional unit of both movement and posture is **The Motor Unit**. A motor unit is a nerve cell and all the muscle fibers that are stimulated by that nerve. When we practice the smooth continuous movements of Tai Chi Chuan, our bodies are stimulated to maintain more motor units because the production of slow smooth movements requires large numbers of motor units. This has an enormous benefit to our health because it is normal to lose motor units as we grow older. When we lose motor units, we lose muscle mass and muscle control. It is widely recognized that the most effective way to increase strength and balance in older adults is to practice activities that increase motor unit recruitment. The practice of Tai Chi requires recruitment of large numbers of motor units, which means that more motor units will be created and maintained even as we age. [1]

The next functional unit of movement and posture we studied was **The Muscle/Tendon Unit**. Muscles are "active" elastic tissues and tendons are "passive" elastic tissues. Muscles change their shape when they are stimulated by nerves; tendons change their shape when a pulling force acts upon them. Tendons connect muscles to bones or other tendons; they also make the actions of our muscles more powerful by storing the force of our muscle contractions. The more slowly a muscle contraction is performed, the more energy is transferred to the tendon part of the unit. This increases the strength of the whole muscle/tendon unit and conditions the tendons to have a wide range of "viscoelastic" properties. Well-conditioned tendons reduce our chances of injury and increase the efficiency of our muscles. Practicing standing postures and doing our forms very slowly helps to keep our tendons conditioned. [2] The viscoelastic properties of tendons make them stiffen or stretch depending on how a load is placed upon them.

Unlike tendons, muscles can actually generate force because of their ability to contract. That is why they are referred to as "active" elastic tissues. We use the term "contraction" to explain what muscles do but the term is a little misleading. We tend of think of "contract" as meaning "get shorter" but when muscles "contract" they can get shorter, get longer, or stay the same length. "Contract" refers to the action of filaments inside the muscles. These filament, actin and myosin, hook on to each other to produce different kinds of contractions. When muscles are at "resting length", meaning they are neither stretched longer nor

pulled shorter, they have the most actin and myosin bonds. The implications of this are HUGE because it means **muscles are strongest at their resting length**. This fact helps us to understand the meaning and importance of "relaxation" when we are practicing our Tai Chi forms. [3]

We looked at all the little parts that provide us with movement: the motor units, the muscles, and the tendons. Next came the mystery of how all these little parts work together to create a whole structure which can move and maintain shape at the same time. The answer to this mystery is **Tensegrity Structure**: structure maintained by tension. Tension, exerted by our elastic tissues, is what stabilizes our structure and keeps it from falling apart when we move. Changing the amount of tension exerted by various muscles allows the whole structure to go into movement. [4]

To understand how a tensegrity structure works, it is helpful for us to visualize a structure which is familiar to all of us. Imagine a spider's web. The spider builds her web by attaching her elastic silk to something, let's say a window frame in our house. When she's finished, her web stretches across the whole window frame and has a certain beautiful shape which is maintained by the tension of all the threads of silk. However, if any of the treads that attach the web to the window frame get torn, the whole web will sag and lose its functional structure. Using this image, we can visualize our structure as a complex "web" of elastic strands connected to our bones. When the elastic strands are sagging (not enough tension being generated) our structure is not well-supported. When the elastic strands are too tight (too much tension being generated) it is difficult to move. When the elastic strands have just the right amount of tension, we can maintain our posture and move at the same time in a way that feels comfortable.

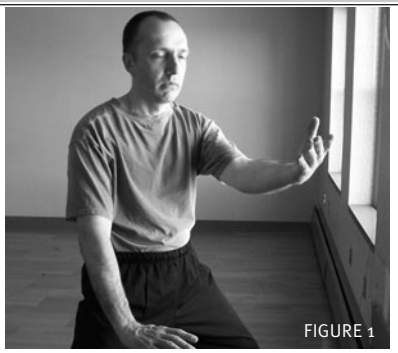
FIGURE 1


FIGURE 2

The 10 Essentials provide us with guidelines that help us to operate our structure with just the right amount of tension in the right places at the right time.*

**Remember, we use the term "tension" from the science of physics where tension means "a pulling force". This is not the same "tension" we use to describe a headache or our reaction to stress. In physics, "tension" does not have a negative connotation, it simply means a pulling force. The spider's web is under tension, that's what gives her web structural integrity. We, too, are continually under the active and passive tensions of our elastic tissues. This kind of tension is a good thing, without it, we would not have form or capability for volitional movement.*

In the most recent essay of this series, we looked at the principle of "containing the chest and lifting up the back". When we embody this principle, we intentionally distribute tension through our structure to achieve a pattern that establishes a beneficial position of our rib cage relative to our vertebral column. This constructive pattern of tension helps us to extend the vertebral column, allowing more upright posture. It also allows our diaphragm muscle to function more efficiently, enhancing our breathing capabilities. [5]

When we looked at this essential principle, "Contain the chest and lift up the back," from the viewpoint of biomechanics and the physics of tensegrity structure, we could see this principal recommended a specific distribution of tension through our bodies which helped us cultivate upright posture and efficient breathing. However we have to be very careful in the way we interpret the meaning of "tension". We may think we have to feel tense when we activate our muscles and tendons. This kind of thinking will get us into a lot of trouble. Figure 1 shows a Tai Chi player interpreting the principle of "contain the chest" with way too much tension pulling his chest downward and inward. He doesn't feel comfortable, he feels a lot of tension! In Figure 2, the same player contains his chest with less tension, now he feels lighter and more balanced. Remember, a tensegrity structure is strongest when the tension acting on it is balanced throughout the whole structure. When the amount of tension acting on different parts of our structure is even, we don't feel individual tensions, we feel balanced. When we feel balanced and light in our movements, in means we have the right amount of tension, acting at the right places, at the right time. If we are feeling tension in a certain area, it means we have too much tension somewhere, rather than a balanced action of tension. This is extremely important to understand as we apply the 10 Essentials in our practice. The paradox is: when the amount of tension is right, we won't feel it as tension, we will feel it as comfort.

In the next essay in this series, we will look at "sink the shoulders and drop the elbows", to explore further what it means to have the right amount of tension, in the right place, at the right time.

1. *The Journal of the International Yang Style Tai Chi Chuan Association*, #16. Pgs. 14-16.
2. Ibid.
3. Ibid. #18. Pgs. 18 – 19
4. Ibid, #19. Pgs. 10 – 12
5. Ibid. #20. Pgs. 10 - 12