Tending the Wind – Chapter 7
Chiropractic – Part 2
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In the 19th century, bonesetters in America and England mended bones, but also treated bones that were "out of place" by forcing them back "in." Daniel Palmer was certainly familiar with the bonesetters' tradition, and likely had some training in it, but perfected his technique into a new profession – chiropractic. Even today, people commonly say their "back is out." However, as chiropractic has evolved along with our understanding of spinal joint anatomy and physiology, we now know that subluxations are a lot more complex and subtle than a simple bone being out of place. A joint does not have to be misaligned to be dysfunctional, or to cause neurologic abnormalities. (Please see http://en.wikipedia.org/wiki/Joints as a visual aid to the following discussion of joint anatomy, http://en.wikipedia.org/wiki/Vertebral_column regarding spinal anatomy, and http://en.wikipedia.org/wiki/Nervous_system for neural anatomy and afferent/efferent pathways. These websites show human anatomy only. See http://www.vetmed.wsu.edu/ClientED/anatomy/nervous.aspx for images of a canine spinal segment showing the spinal cord and intervertebral discs.)

An *articulation* is any type of joint between bones. Three functional types are described: *synarthroses* (permitting little to no movement), *amphiarthroses (*permitting limited movement), and *diarthroses* (permitting a wide range of movements). The union of adjacent vertebral bones is quite complex since the vertebral column must provide flexibility while also protecting the delicate spinal cord that runs within its length. There are actually three separate articulations between vertebrae – one amphiarthrosis where each disc resides below the spinal cord in quadrupeds (in front of the cord in bipeds), and two diarthroses above the cord near the spinous process (the bump you can feel on the midline of the back). The largest part of each vertebral bone between discs is called the *vertebral body*; the parts that face each other at the diarthroses are called *articular facets*. (An exception to this arrangement is the meeting between the first two cervical vertebrae in the neck, which consists of three diarthrodial joints.) All spinal joints have cartilage between the bones, but in amphiarthrodial joints involving discs the cartilage is firmly attached to both vertebral bodies, while in the diarthrodial joints (also called *synovial joints*) the cartilage attached to each bone is separated by *synovial fluid* – a highly viscous lubricant. Synovial joints are lined by a membrane which provides nutrients to the cartilage, and are protected by a fibrous capsule. Strong and variably elastic ligaments form several connections between bones, and are contiguous with joint capsules where they cross over synovial joints.

Intervertebral discs (also spelled *disks*) are shaped like hockey pucks, and are composed of a semifluid gel center (*nucleus pulposus*) encircled by a fibrous cartilage outer ring (*annulus fibrosus*). The nucleus is deformable, but considered incompressible (hence the disc's major role in handling compressive forces through the spine). It contains a high percentage of water which decreases with age and repeated stress. The annulus keeps the nucleus in place during compression, and although its fibers are not very elastic, it does allow some motion between vertebral bodies. Excessive rotational or shear forces can tear the fibers, allowing the nucleus to protrude (commonly referred to as a "slipped disc"). The flat sides of the disc are firmly attached to adjacent vertebral bodies by an *endplate*, composed of the same type of cartilage (hyaline) that covers the articular facets.

Muscles attach to various surfaces of the vertebrae, the larger ones contributing to gross body movements and the smaller ones handling finer relations between vertebrae. The muscles are considered to be the main stabilizers of the joints, and are responsible for shock absorption as well as controlled acceleration, deceleration and sustained tension. If they fail to function properly, the ligaments must bear extra stress, followed by the discs and articular cartilage, and finally the bone. Trauma to muscles can be acute, but more commonly the damage is insidious resulting from the ongoing stress of poor posture, repetitive movements, and sustained loads. The resulting strain to joint tissues creates a cycle of pain, inflammation, muscle spasm, connective tissue fibrosis (scarring), and, most importantly, joint fixation (also termed *hypomobility*).

Proper blood supply to all of these tissues is critical, and is compromised by stress and tension around the joint. Poor blood supply leads to tissue starvation and further inflammation. Muscles and bones have direct blood supply, but cartilage and ligaments contain no vessels, and must rely on neighboring tissues for nutrition.

Finally, we come to the nerves…here's where things get more hypothetical, and where the crux of the matter lies for chiropractic.

Palmer stated that subluxations are bony displacements causing disease by pinching nerves as they exit the spinal cord through the space between adjacent vertebrae. In the absence of disc herniation or bony remodeling, however, direct anatomic compression of nerve roots by displaced bones has not been confirmed as the key factor in subluxation-induced disease. Nor is it known whether stress to local blood vessels, either by bony displacement or altered joint mobility, is sufficient to cause significant nerve damage. This anatomic model, called the *non-impulse-based* model, has been challenged in recent years by a functional, *impulse-based* model. In this model, nerve impulses carrying information to and from the spinal cord play the central role.

Efferent nerves carry information out of the spinal cord, sending instructions to various organs and tissues. *Afferent* nerves carry sensory information from organs and tissues back to the spinal cord. Some of this information is processed within the cord, and some is sent on to the brain. Sensory information to afferent nerves is provided by various types of receptors. Most important in impulse-based subluxation theory are *mechanoreceptors* (sensing movement) and *nociceptors* (sensing pain). Both types of receptors reside in the ligaments and joint capsules of the spine; there are also nociceptors in the annulus fibrosus of the disc (and some evidence of mechanoreceptors).

Research suggests that information from nociceptive afferents is toned down in the spinal cord by information from the faster-signaling mechanoreceptive afferents. Normal joint mobility thus allows regulatory inhibition of pain signals. In joint fixation, whether or not there is bony displacement, appropriate mechanoreceptor stimulation is missing because the joint isn't moving normally. Uninhibited pain signals from stressed or inflamed ligaments, joint capsules and discs then cause altered spinal cord neural processing, and reflex changes in efferent signals to the organs and tissues served by that spinal cord segment. The result is further joint dysfunction due to reflex muscle guarding, and physiologic dysfunction due to reflex stimulation of the sympathetic nervous system. The High-Velocity, Low-Amplitude (HVLA) adjustment is thought to restore normal neural processing by stimulating mechanoreceptors whose afferent signals interrupt abnormal reflex patterns. Thrusts that cause joint separation and stretching (either along or at right angles to the articular plane) provide better stimulation than thrusts that cause joint compression.

The altered neural patterns created by joint hypomobility and excess nociceptive input can remain long after that input ceases. Repetition of the same afferent signals creates long-lasting alterations in how the spinal cord responds to all future signals – a process called *reflex entrainment*. This is why joint dysfunction can persist even after the pain is gone, and why it continues until neural reflexes are normalized. Reflex entrainment also results in lowering of the pain threshold, so that it takes even less nociceptive input to disturb homeostasis. In this model, actual bony displacement is likely the result rather than the cause of neuromuscular dysfunction, due to chronic reflex muscle spasm and long-term damage to ligaments.

Research is ongoing, and a specific mechanism for chiropractic's benefits has not yet been determined. As with most things in living organisms, the reality of joint dysfunction is likely more complex than either model. What we do know is that the HVLA thrust moves articulations, stretches tissues, and stimulates the nervous system in a manner different from other forms of spinal therapy. The most important difference may be its speed, because one of the three mechanoreceptor types only responds to rapid changes in joint movement. (The other two will fire with slower movements and sustained loads.) The other important difference is its precision, directing energy into a narrow field of focus. The next chapter explores the application of HVLA adjustments in animals.