

The Spine and The Gain Theory

The Spine - An Elegant System

It provides a supple and yet stable structure capable of smooth, coordinated and often complex movement. In discussion with engineers whatever the spines underlying system it must comply with the universal laws of physics. Design a stable mast = Steel Rod. Design a supple mast = Rubber Rod. Combining the two is very difficult! Yet the spine elegantly solves the problem.



The musculo-skeletal system is a passive system in which muscular activity decays unless actively maintained. This characteristic results in a general state of inactivity. This inactivity is essential to allow smooth complex movement. (A Passive System) In contrast robots with their active hydraulic pistons never relax via a similar decay thus giving a constantly rigid system. (An Active System) The active system control is simple and requires either an increase or decrease in the level of on-going activity. The passive system of the spine is however a degree more complex. Once again evolution has found an elegant solution to give smooth coordinated movement. The mechanism combines three independent systems:

- 1) Cerebral - The motor cortex generates voluntary movement (Upper Motor Neurone)
- 2) Cerebellar - Controls muscular tone by dampening reflex arcs (Gain) (Upper Motor Neurone)
- 3) Stretch Reflex Arcs - Ensure a balanced system with each stress being opposed by an equal and opposite strain (Lower Motor Neurone)

The Gain Theory

Any ability to take a strain is directly dependent upon the gain. At high gain, the system will be stiff and the movement sharp and strong (Attack). At low gain, the system will be tender and movement progressive but weak (Relaxed). In theory we should be equally vulnerable during both high and low gain activities. Commonly we hear that a man pulls his car out of a ditch (high gain) without injury and yet 'puts his back out' while tying his shoelace (low gain). Damage can occur at any time when the gain is insufficient for the task being undertaken resulting in rotation or damage. Since the majority of activity is low gain it makes sense that this is when the majority of crippling back injuries occurs naturally explaining the paradox. Avoidance of high gain activity therefore offers no security. The only solution is to improve the mechanical efficiency of the spine.

Postural Control

In producing either resting body posture or strenuous work an equal and opposite reaction is transmitted through the body. At any individual point precise reflex tensioning is occurring giving a dynamic response to the situation. In this the stretch reflex arcs are continually stimulated until the appropriate tension has been achieved. This occurs on every occasion that the tension across a muscle is momentarily greater than the contractile force it is producing. As muscles have no fixed length they comfortably adopt new positions without resistance; they do not act like springs. The final response will be in direct proportion to the resultant force at each point. This applies regardless of the number of individual actions involved in its production. (Complex actions are automatically blended). Conversely when the stress is reduced natural decay automatically occurs reducing the muscle tension. Such a system is therefore self-compensating and error free. The spines posture and stability is therefore constantly monitored and adjusted by multiple independent reflexes aligning it in the direction for most effective support. It is as a result of this continuous interaction between strain, gain and decay that the spine achieves supple stability. It follows that for each force transmitted through the spine a natural coordinated movement will result with the strain being shared equally across all the involved joints. Unfortunately the spine cannot withstand unlimited stress and therefore with time its conformation changes. Joints become damaged/rotated, discs worn; muscles tense inappropriately restricting movement and ligaments increase in laxity or fibrose. These changes alter the way in which stress is transferred through the spine. Eventually much of the back suppleness is lost resulting in the stress being spread across fewer joints. These joints now bearing proportionally more of the strain will be damaged. This characteristically occurs in the lower cervical and lumbar regions. This local damage produces the chronic pain we associate with 'the common back problem'.

Restoring the Spine

As a child or young adult our spine was in a supple condition and correctly aligned. In this state the spine worked efficiently without excessive stress to any area. To realign the spine two key processes are required. One is to mobilize the inter-vertebral joints to restore their earlier range of movement. Since clearly in the presence of insufficient vertebral mobility minimal realignment can occur. The second is to relax the supporting muscles to allow realignment. This is achieved through random and repetitive reflex stimulation. Naturally, once relaxed, the spine will adopt the most efficient position for energy transfer. This gradually corrects any vertebral misalignment where structurally possible, returning to its youthful form. As a result, function is restored and the strain is spread across the whole back rather than over a few joints. Once properly functional further damage is reduced and injured areas are given the opportunity to repair. Excessive treatment cannot achieve further improvement once the most energy efficient alignment has been found; this in itself is self-protective.

The 30 Day Program giving Functional Restoration

ASMI = Advanced Spinal Mobilization Instrument (The therapists tool to allow a tireless and unique form of manipulation)

- A. Spasm
Rapid muscle stimulation resulting in relaxation.
- B. Reflex
Repetitive and firm muscle contact resulting in local reflex stimulation. This not only improves their function (strength) but also produces re-alignment of vertebra as allowed by their current mobility.
- C. Mobilization
A highly efficient passive procedure of inter-vertebral counter rotation of adjacent vertebrae thus restoring mobility.
- D. Postural exercise
Walking tall for ten minutes (Postural muscles).

