

# Spinal Anatomy

## Overview

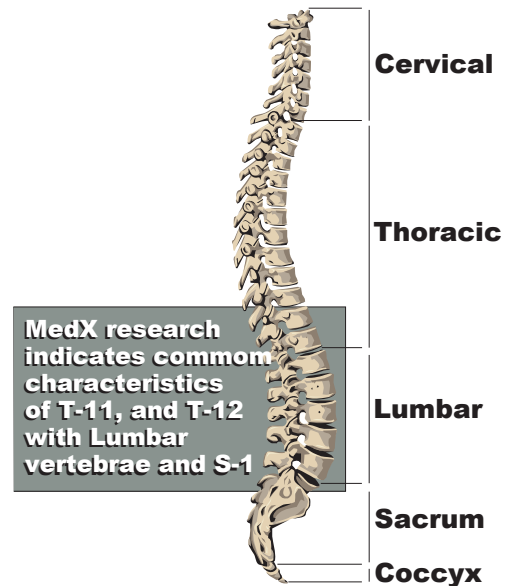
Neck and back pain, especially pain in the lower back, is one of the most common health problems in adults. Fortunately, most back and neck pain is temporary, resulting from short-term stress on the muscles or ligaments that support the spine rather than from a serious injury or medical condition such as nerve damage or kidney disease.

## Anatomy

The back is an intricate structure of bones, ligaments, muscles, nerves, and tendons. The backbone, or spine, is made up of 31 bony segments called vertebrae:

- 8 cervical (neck) vertebrae
- 12 thoracic (middle back) vertebrae
- 5 lumbar (lower back) vertebrae\*
- 5 sacral (lowest area of the back) vertebrae
- 1 coccygeal (coccyx, or tailbone) vertebra (made up of several fused segments)

\* MedX research contends that the lumbar region really starts at T-11, based upon the attributes of the vertebra.



The vertebrae are arranged in a long vertical column and held together by ligaments, which are attached to muscles by tendons. Between each vertebra lies a gel-like cushion called an intervertebral disc, consisting of semifluid matter (called nucleus pulposus) that is surrounded by a capsule of elastic fibers (called annulus fibrosus).

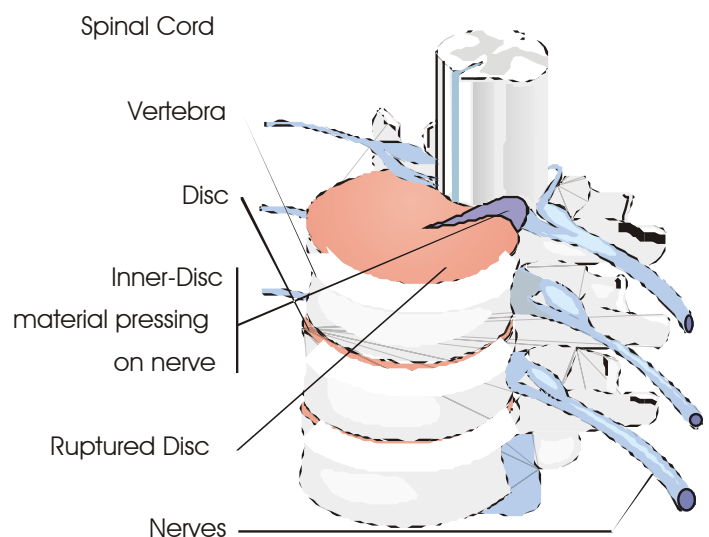
The spinal cord is an extension of the brain that runs through a long, hollow canal in the column of vertebrae. The meninges, cerebrospinal fluid, fat, and a network of veins and arteries surround, nourish, and protect the spinal cord.

Thirty-one pairs of nerve roots emerge from the spinal cord through spaces in each vertebra. The spinal cord and peripheral nerves perform essential sensory and motor activities of the body. The peripheral nervous system conveys sensory information from the body to the brain and conveys motor signals from the brain to the body.

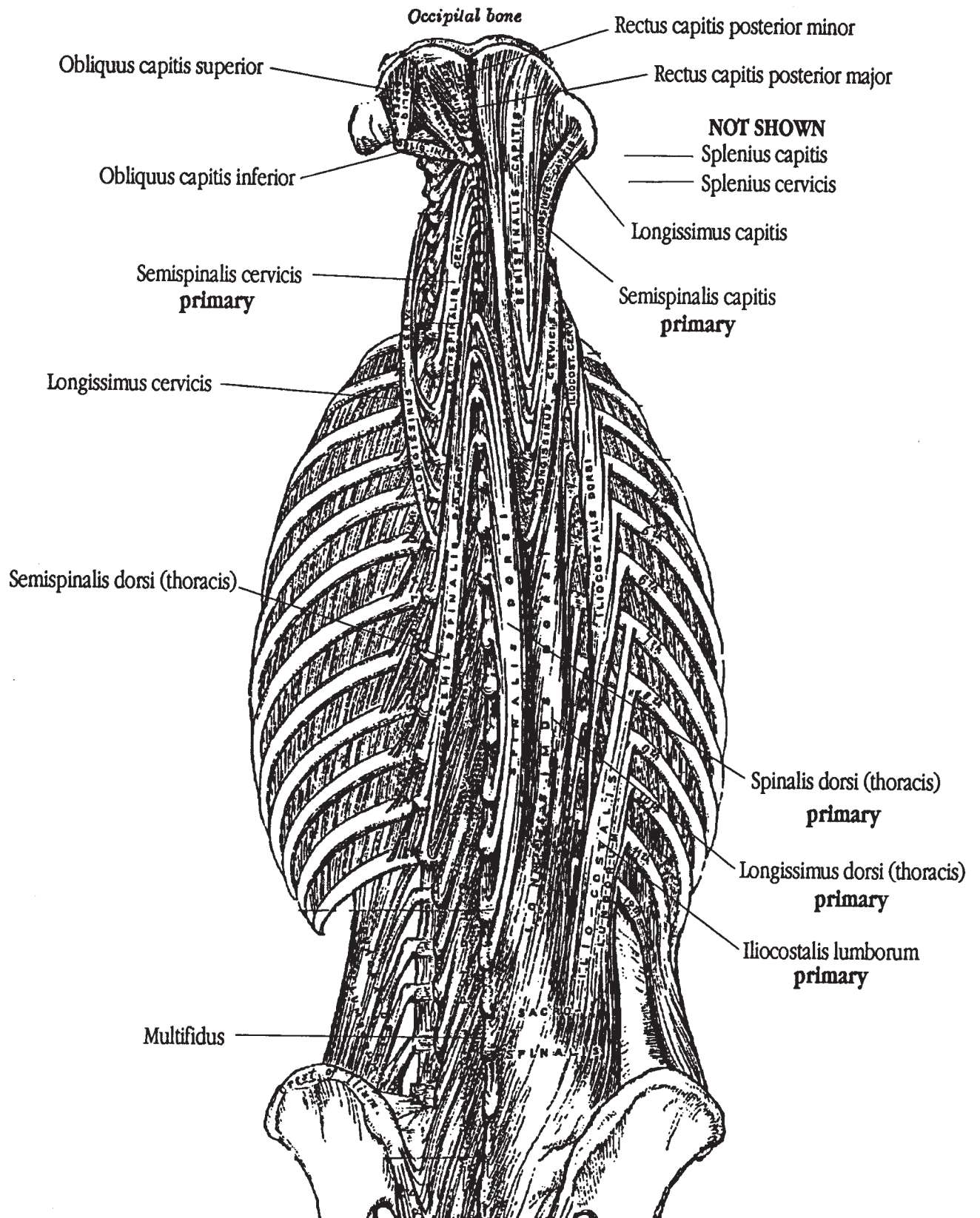
## Incidence and Prevalence

In the United States, back pain is reported to occur at least once in 85% of adults below the age of 50. Nearly all of them will have at least one recurrence. It is the second most common illness-related reason given for a missed workday and the most common cause of disability. Work-related back injury is the number one occupational hazard.

Following injury, healing occurs in three stages; inflammation, repair and remodeling.



# Cervical and Lumbar Musculature



Posterior View

# Structural Integrity of the Lumbar Spine

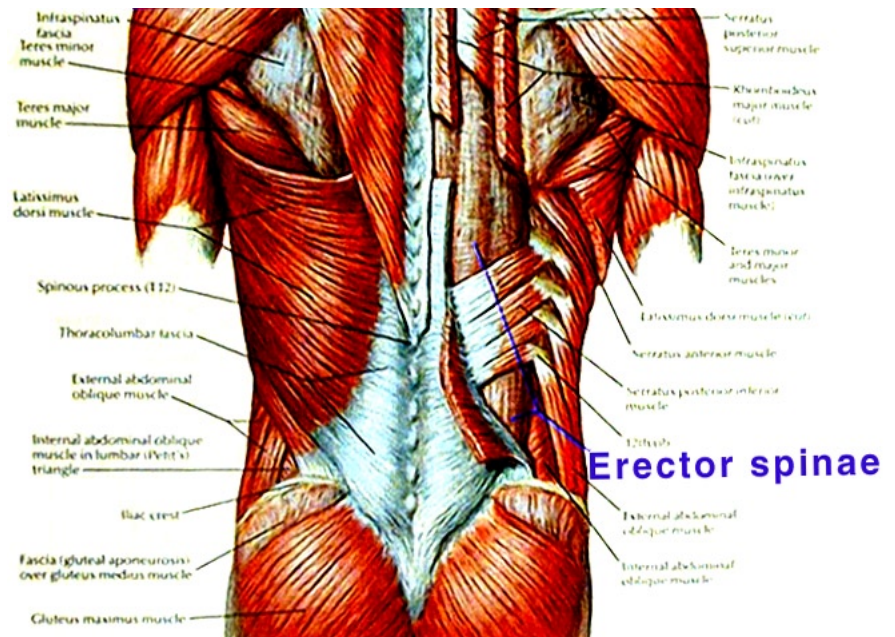
While the upper part of the spine, above T 10 through T 1, is supported by the closed ribcage, the lower spine is supported primarily by the muscles, the tendons and the ligaments in that area. Weakness in any of these support structures can lead to injury.

Soft tissue injury results from failure of collagen fibers, and the type of injury can be either microtrauma resulting from overuse, and macrotrauma resulting from the imposition of a force that exceeds the structural strength of the tissues. A higher level of structural strength can withstand a higher level of force.

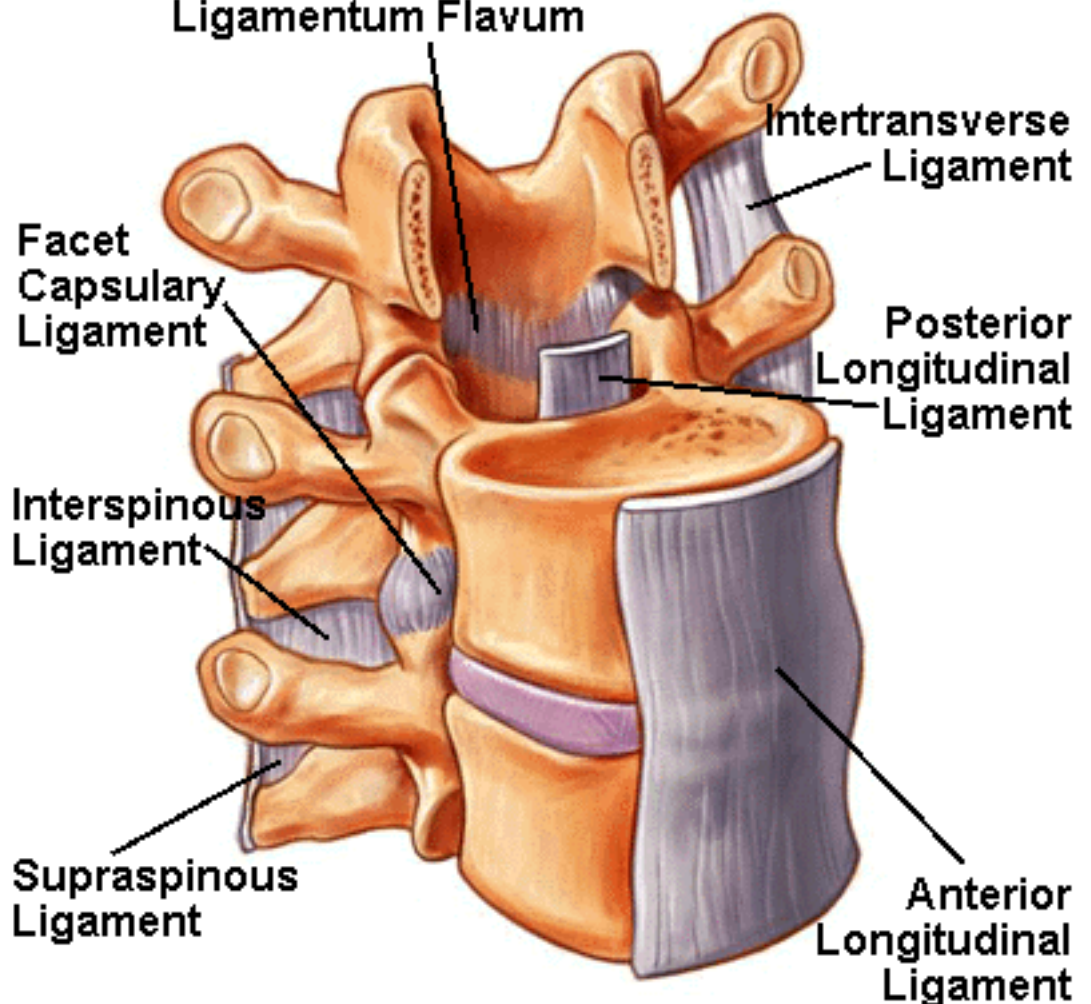
*Structural* strength can be determined through its correlation to *functional* strength, and MedX medical machine testing can accurately measure functional strength. Exercise increases the size and strength of the muscles, tendons, ligaments and bones; thus increasing structural strength and reducing chance of injury.

The spine is designed to permit bending and twisting, but is also intended to prevent bending or twisting beyond a degree that would become dangerous. In some ways the spine is similar to a tall, thin tower whose resistance against horizontal force is provided by cables attached to the tower and anchored in the ground. The muscles, tendons, and the ligaments support the spine in a similar way.

But unlike the



## Ligamentum Flavum



## Structural Integrity of the Spine (cont.)

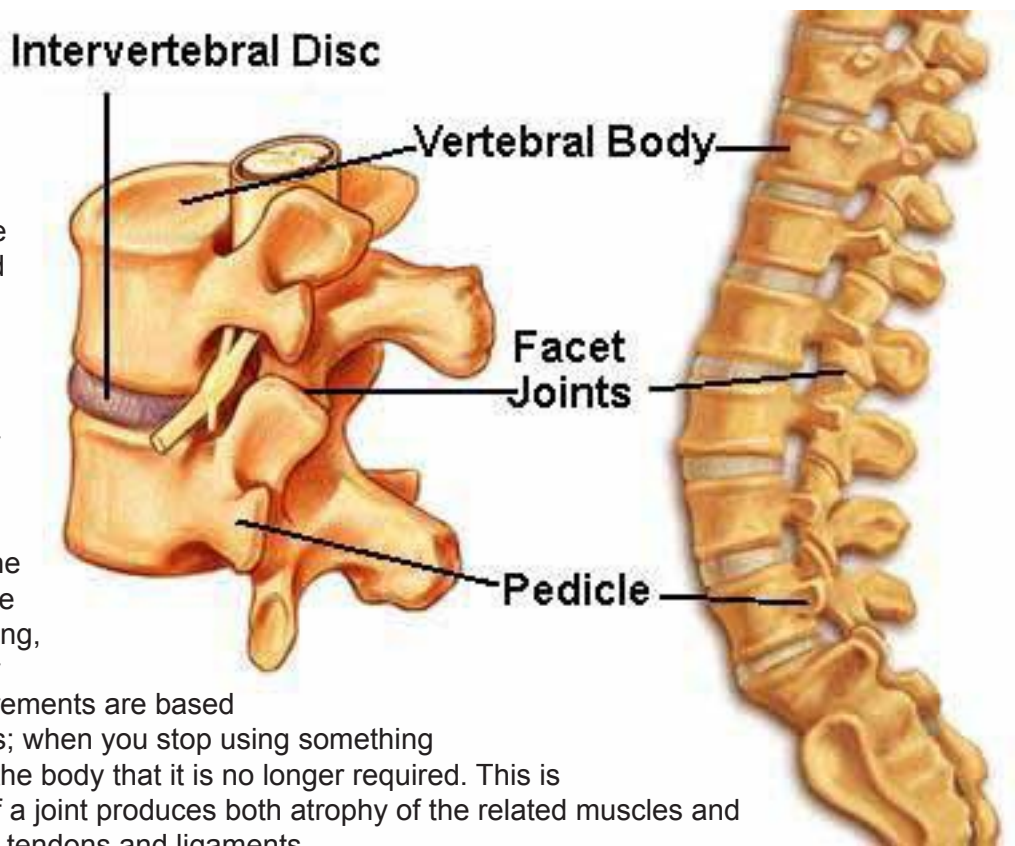
cables supporting a tower, the spinal support structures resist both pulling and compression forces. The bones and discs of the spine are primarily intended to resist compression forces, and provide very little in the way of resistance against forces from any other direction.

Just as with all of the tissues in the body, the soft tissue of the spine are constantly changing, becoming stronger or weaker. Future requirements are based upon recent demands; when you stop using something you send a signal to the body that it is no longer required. This is why immobilization of a joint produces both atrophy of the related muscles and tissue changes in the tendons and ligaments.

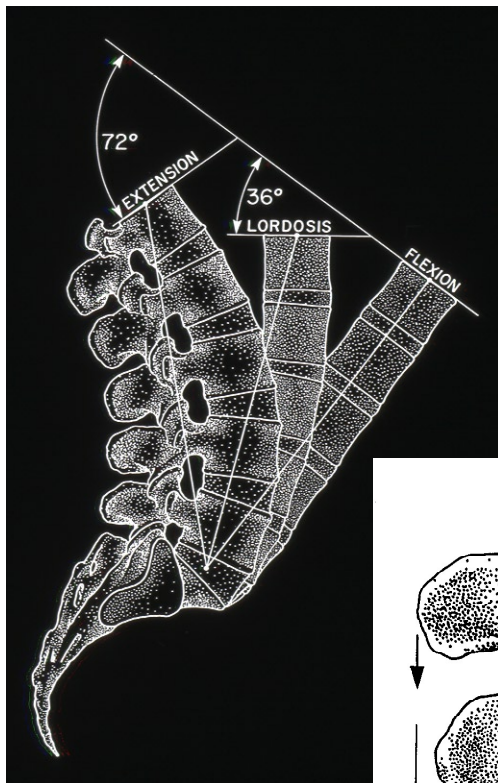
But when you use these tissues at a level that is close to the momentary limit of functional ability, as an adaptive organism the body improves physiologically to meet the demands imposed upon it. Proper exercise stimulates these positive adaptations.

Proper exercise is important for every voluntary muscle in the body, but even more critical for the muscles of the spine. Large-scale tests involving many thousands of individuals at the University of Florida produced a surprising picture: most of us - including highly trained athletes - have weak lumbar extensors. However, even more amazing was the level of this weakness. By exercising these muscles on MedX equipment, it was possible to increase strength by several hundred percent!

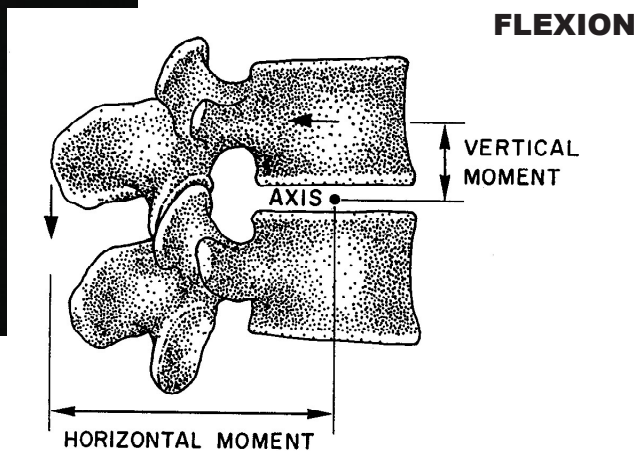
According to leading orthopaedic specialists, some 80% of all back problems are the result of weak back muscles, or to be more precise, a weakness in the lumbar extensors. On the basis of these findings, scientists at the University of Florida developed a therapy that produced spectacular results in patients with chronic back problems. That system is based upon MedX patented technology.



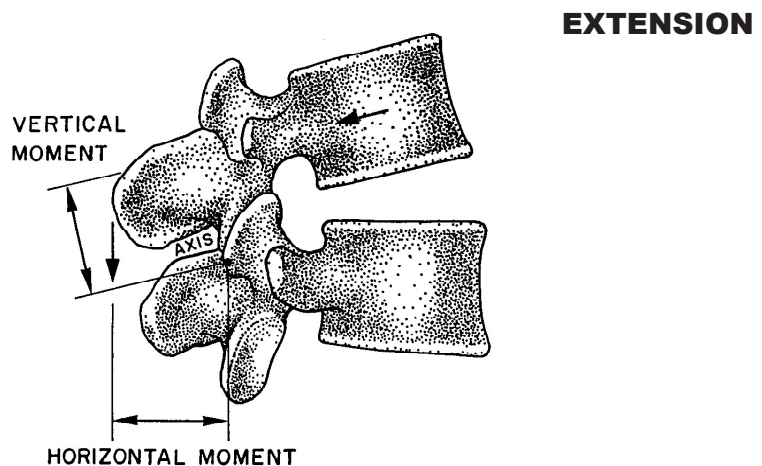
## Understanding Mechanical Advantage



These drawings indicate the mechanical advantage in the flexed position — meaning that less force is needed to generate torque due to the leverage of the joint system. In extension, the axis of rotation shifts from between the vertebral bodies to rear of the posterior face of the lumbar vertebrae, essentially in the facets.



By using lateral X-ray pictures in the flexed and extended positions, it is possible to determine the angular relationships of the lumbar vertebrae as the spine moves from flexion (artistic rendering above) to extension (artistic rendering below).



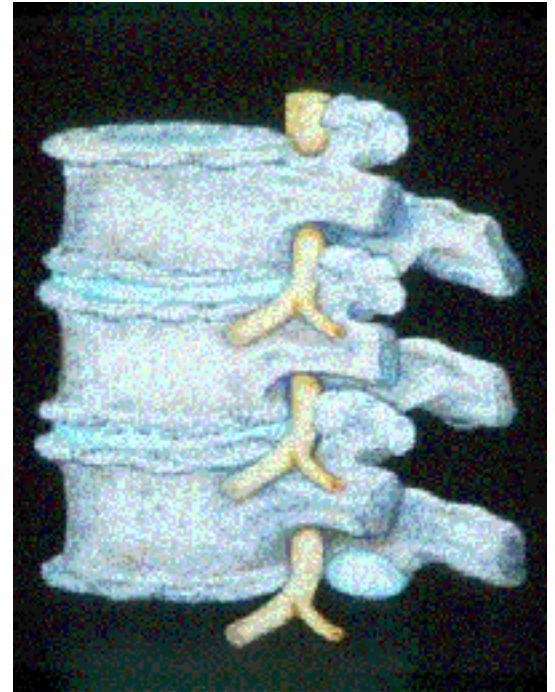
## Disc Disease

Left lower photo depicts segments of the spine: vertebral body, intervertebral disc, articular facet, and intervertebral foramen with nerve root.

Right photo shows results of process that began with herniation of the intervertebral disc, associated ligament laxity and entrapment of the nerve root. A loss of



disc space then occurs with further ligament laxity. Eventually, facet joint arthritis leads to bony overgrowth and stenosis of the intervertebral foramen. MedX not only strengthens spinal muscles, but hydrates the discs also.



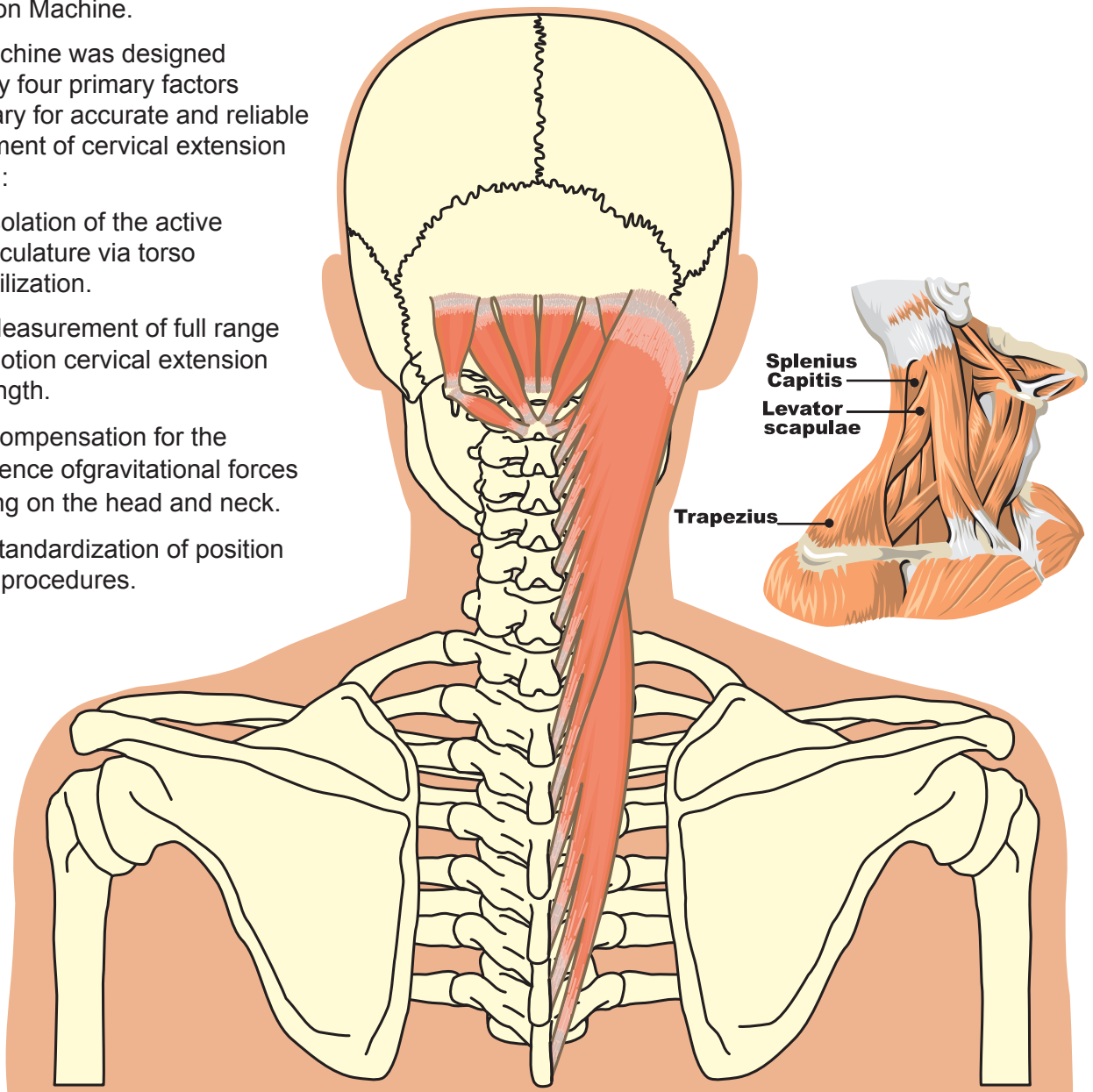
# Safeguarding the Cervical

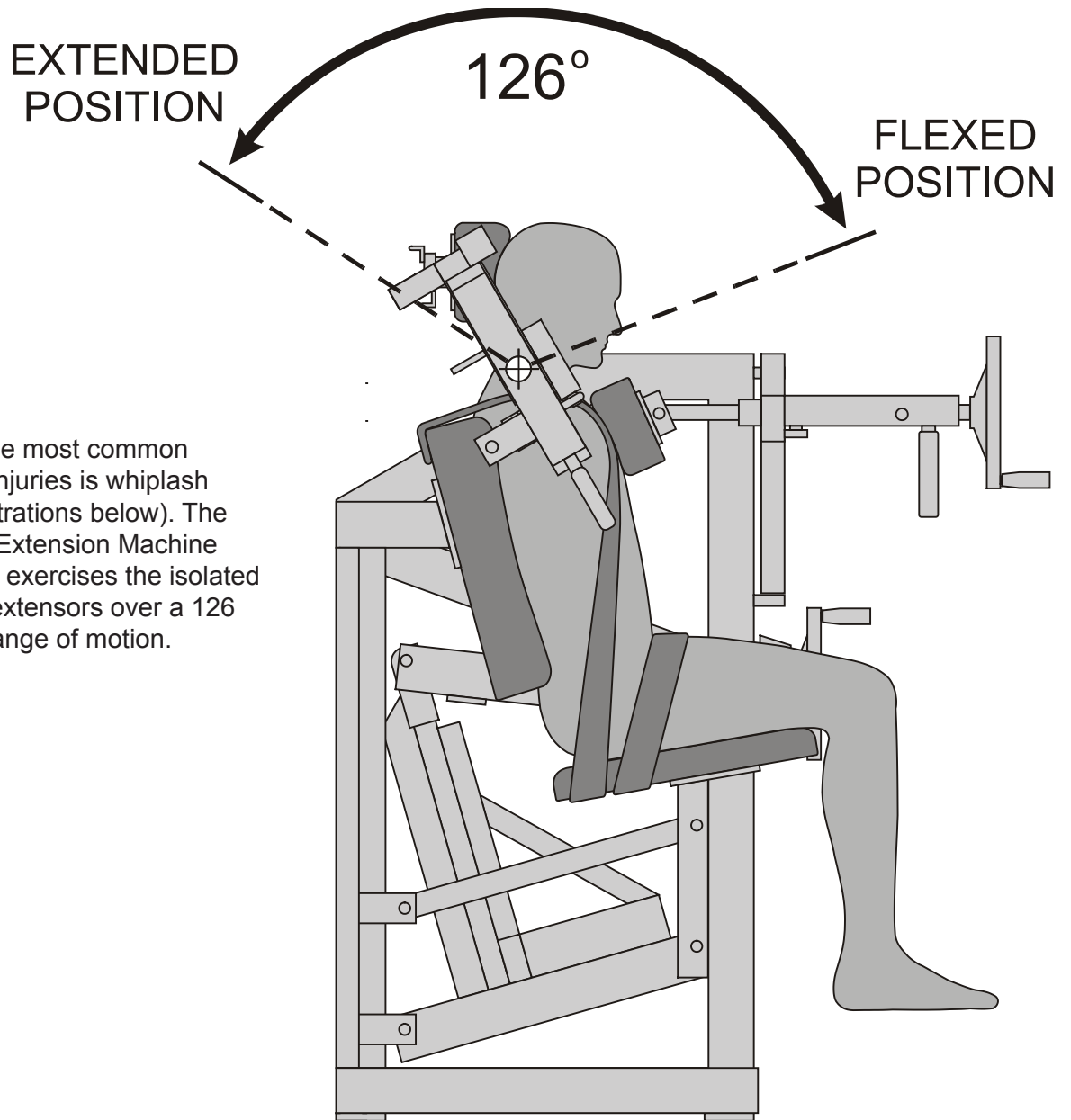
Head and neck pain are common and costly concerns that plague a vast number of individuals in modern society. Neck pain often originates from muscular weakness and fatigue, and from injuries associated with accidents and participation in athletics. Neck injuries are especially prevalent in high impact activities such as football, wrestling, diving, and gymnastics. Cervical spine injuries are caused by contact, overuse, twisting, compression, direct shearing forces, and alignment abnormalities.

Neck muscle strength has been shown to be a controlling factor in the stability of the cervical spine. The importance of strengthening the neck musculature to reduce the risk of injury, alleviate neck pain, and in rehabilitation has been well documented, particularly in research using the MedX Cervical Extension Machine.

This machine was designed to satisfy four primary factors necessary for accurate and reliable assessment of cervical extension strength:

- 1) Isolation of the active musculature via torso stabilization.
- 2) Measurement of full range of motion cervical extension strength.
- 3) Compensation for the influence of gravitational forces acting on the head and neck.
- 4) Standardization of position and procedures.





One of the most common cervical injuries is whiplash (see illustrations below). The Cervical Extension Machine tests and exercises the isolated cervical extensors over a 126 degree range of motion.

