ANTERIOR APPROACH IN TREATMENT OF SCOLIOSIS

THESIS

Submitted in partial Fulfilment Of Master Degree In Orthopaedic Surgery

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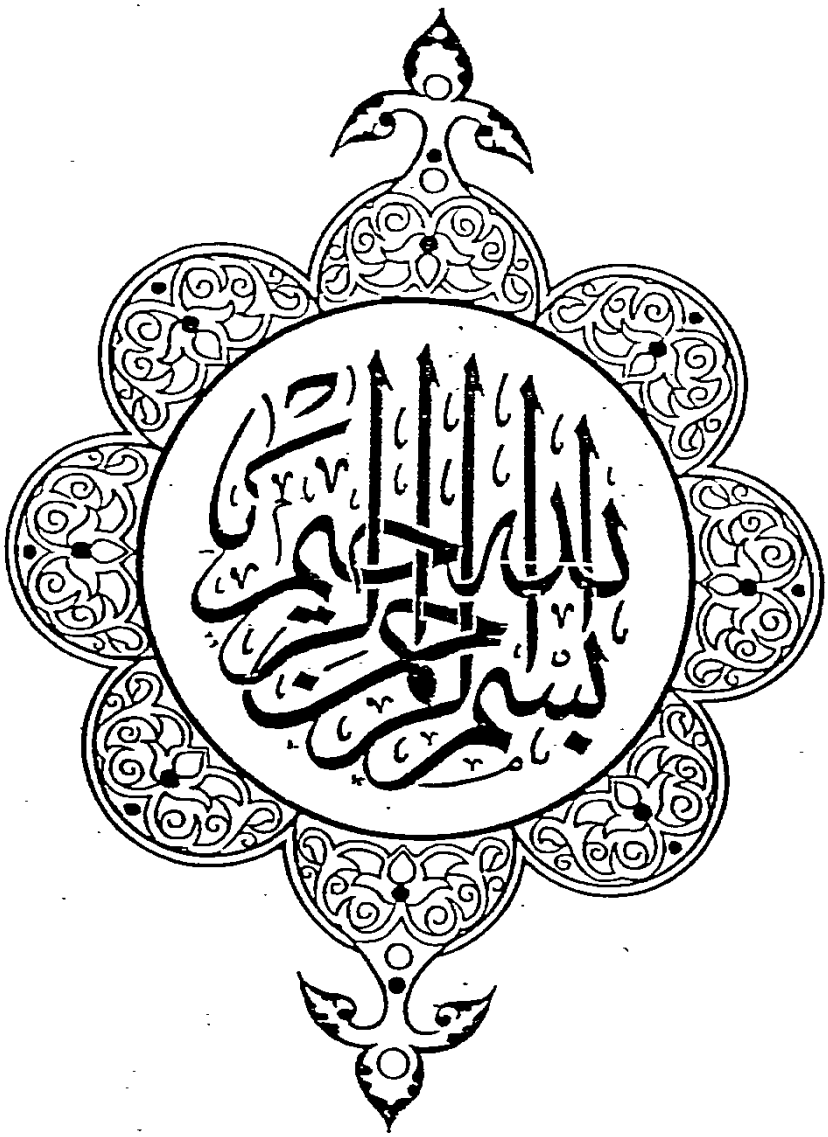

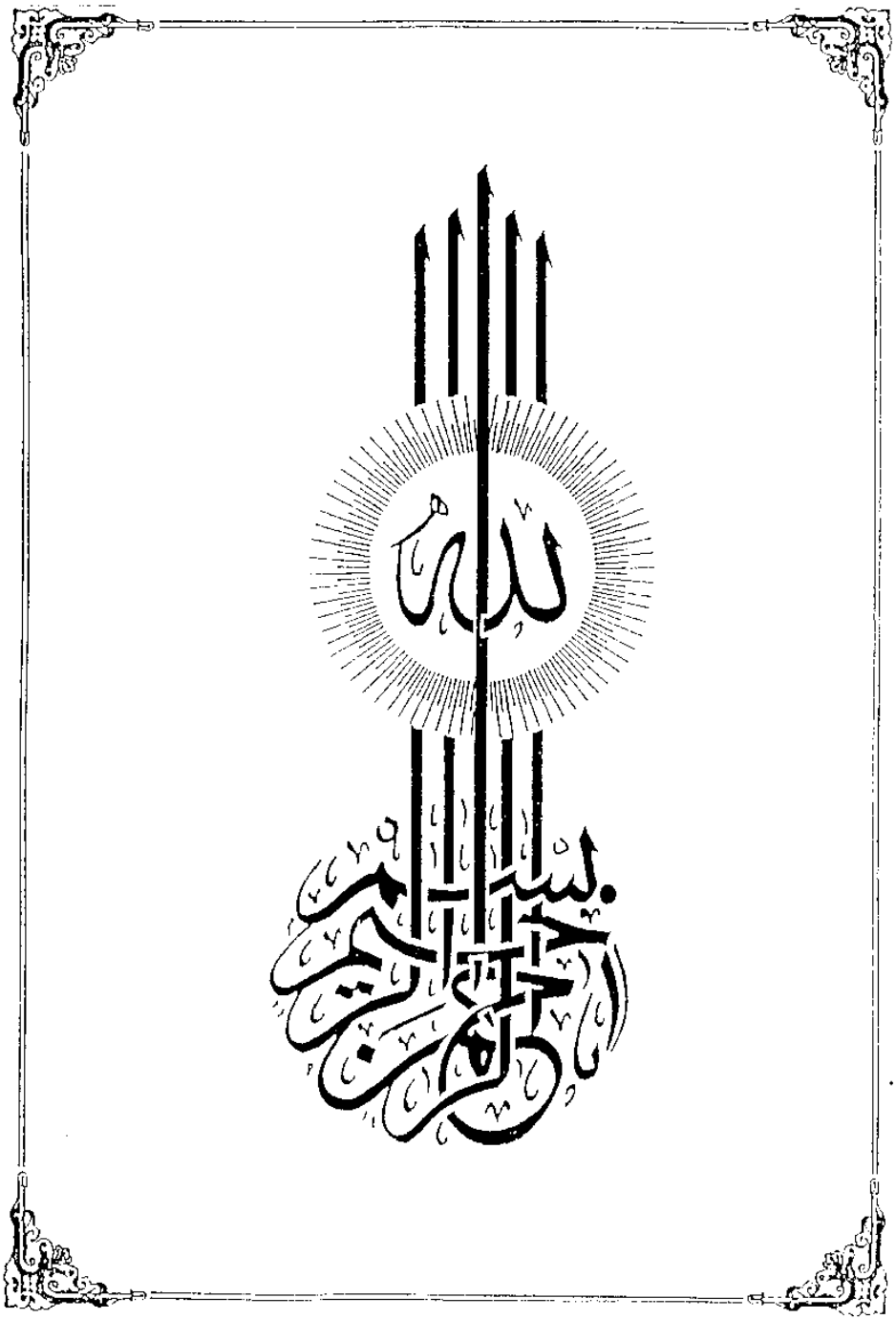

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Magdy Abdel Hakiem El Morsy.

C O N T E N T S

INTRODUCTION

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This essay is submitted for partial fullfilment of M. Sc. degree in orthopaedic surgery.

The aim of this report is to study and evaluate the anterior approach in the treatment of scoliosis and it is hoped that this study would point out the value of this approach in treatment of scoliosis.

The essay deals, at first, with the configurational anatomy of the spine with special reference to it's anterior relations, movements and the factors affecting it's stability.

Then the biomechanics of the spine is discussed followed by the biomechanical changes occure with scoliosis. The biomechanics following anterior instrumentation is finally discussed.

The anterior approach to the different levels of the vertebral column, the thoracic spine, the thoracolumbar spine and the lumbosacral spine is discussed in details.

Then the new instrumentation techniques applied by Dwyer and Zielke are discussed in details. The

description is started after the anterior exposure of the desired level of the spine to be instrumented.

Possible complications and how to be avoided, evaluation of each technique and the advantages and disadvantages are discussed.

Finally, we should like to emphasize that the anterior approach to the spine specially with the use of the new techniques of instrumentation has proved to be an excellent means of dealing with scoliosis.

ANATOMY

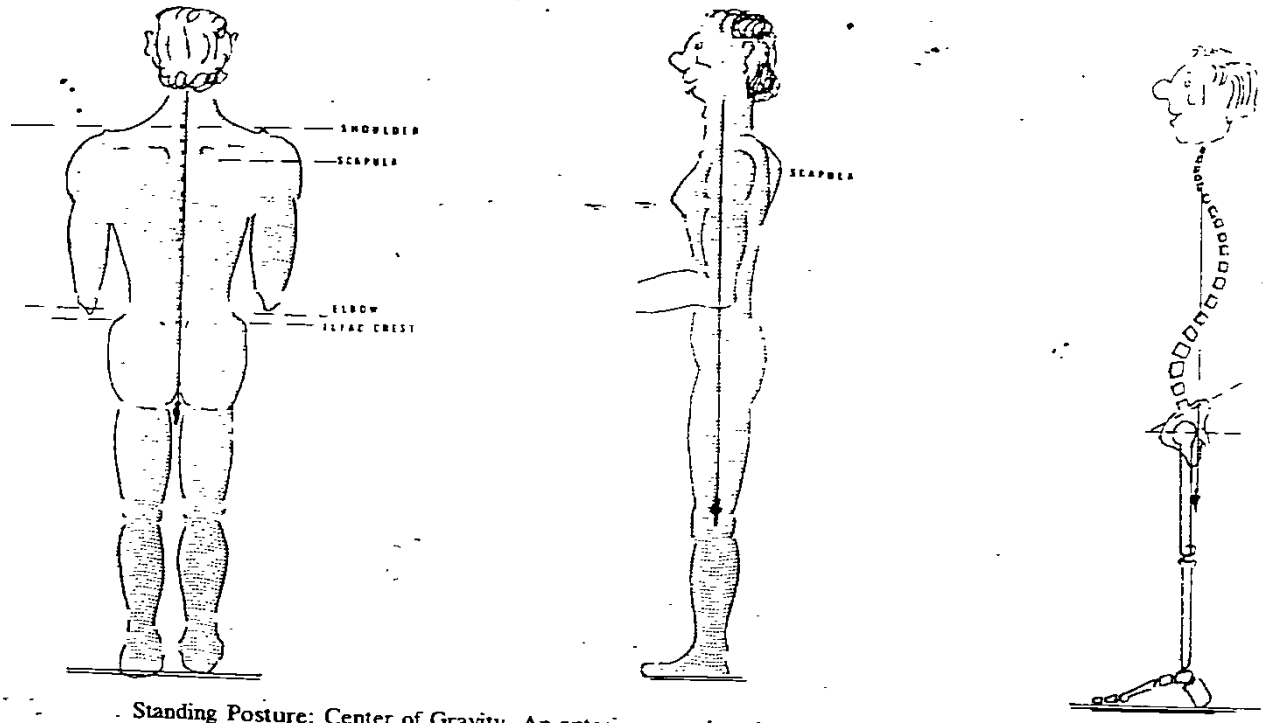
NORMAL SPINAL ANATOMY

The normal spine is composed of 33 vertebrae, separated by intervertebral disks superincumbent on each other, that form the vertebral column. The entire column, supported upon the sacrum in vertical alignment, forms four physiological curves. These four curves are termed cervical and lumbar lordosis with the convexity anteriorly and dorsal and sacral kyphosis with convexity posteriorly.

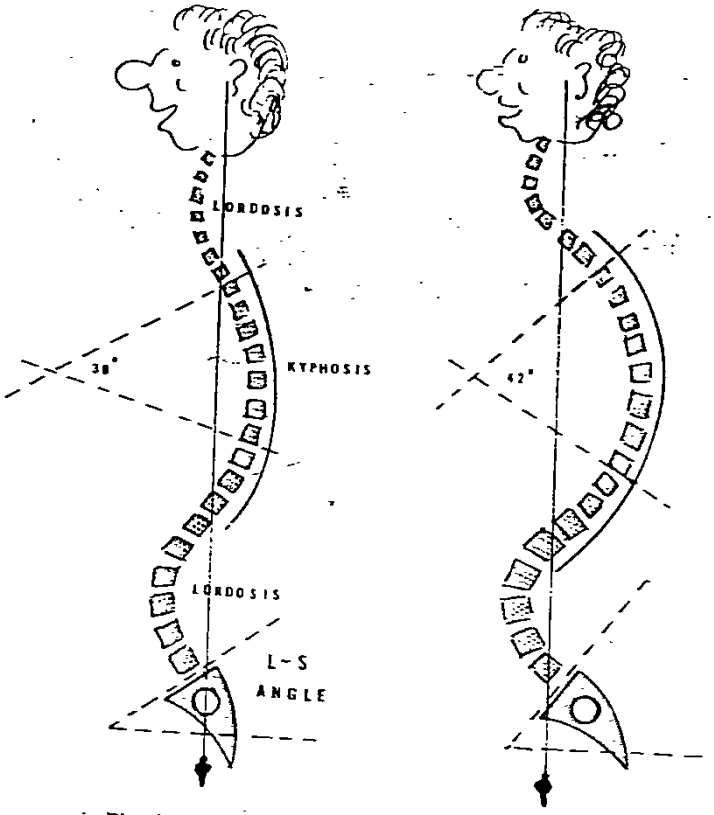
The erect stance is balanced upon an angled sacrum that forms the lumbosacral angle with the horizontal plane. The head must be well balanced above the sacrum so that a plumb line visably passes through the ear, through the shoulder joint, through the greater trochanter of the femur, slightly anterior to the knee joint midline, and ends anterior to the lateral malleolus. These are clinically discernible surface landmarks. (Fig. 1).

A similar center of gravity when viewed anteriorly-posteriorly should pass from the occiput through the tip of the coccyx.

Stance in the erect position is considered static and is termed posture. The erect body is intermittently supported by ligamentous tissues and muscles with good erect balance requiring that physiological ligamentous support alternate with minimal isometric muscle contraction.



Standing Posture: Center of Gravity. An anterior-posterior view of the center of gravity (left) should show th plumb line decending from the occiput through the sacrum. A lateral view (middle and right) should show the plumb line passin through the cervical vertebrae, through the shoulder of the dangling arm, posterior to the hip joint, anterior to the center of th knee joint, and slightly anterior to the ankle lateral malleoli.



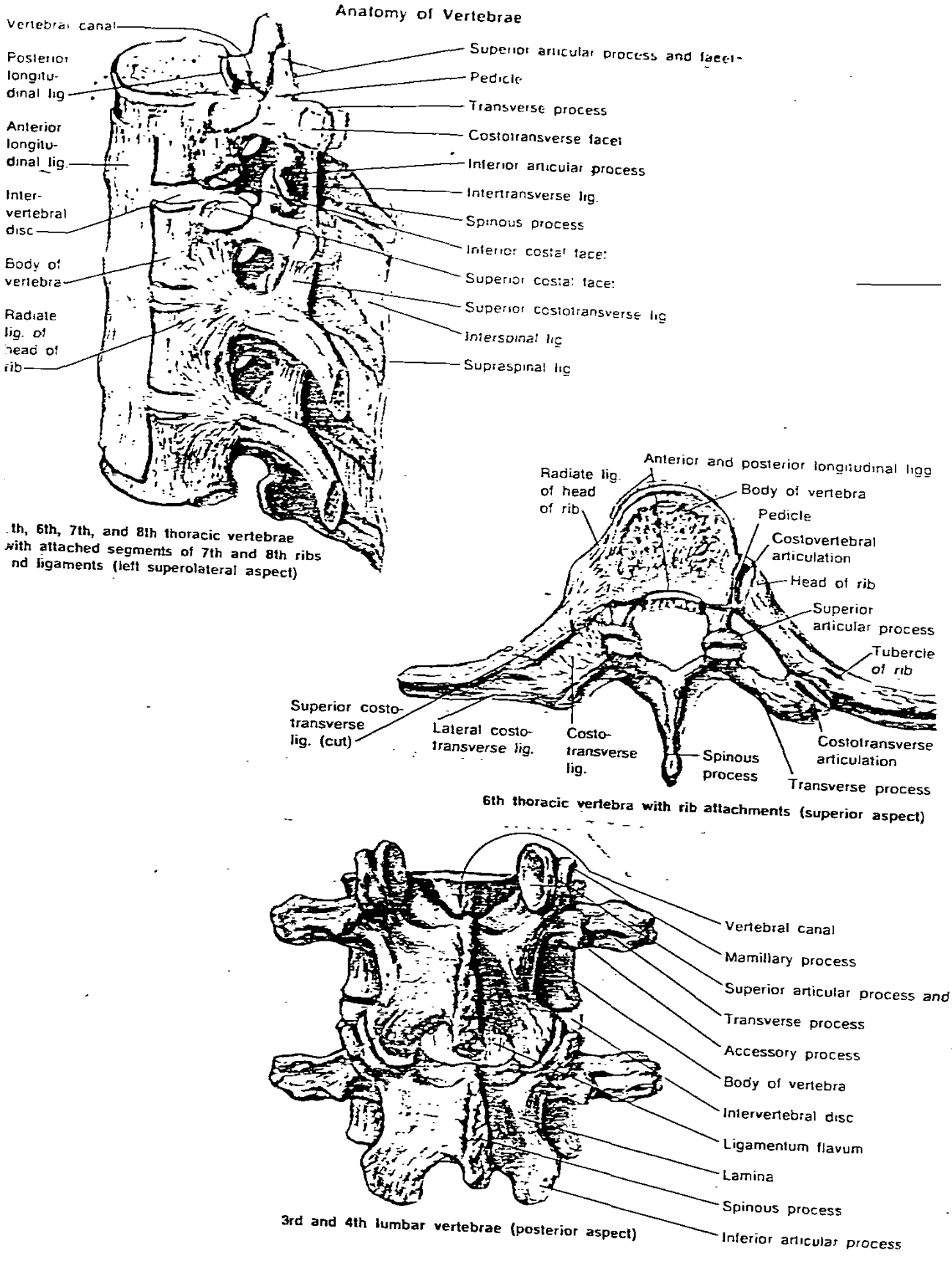
Physiological Postural Curves. The figure on the left depicts the physiological curves with the head directly above the pelvis. The dorsal kyphosis is approximately 30°, which is physiological. There is also a slight lumbar lordosis. The figure to the right shows a "round back" caused by increased dorsal kyphosis. The head is held forward of the center of gravity. The lumbar lordosis is exaggerated because of an increased lumbosacral (L-S) angle.

(Fig. 1) From Rene Cailliet, Scoliosis, Diagnosis & Treatment.

When the spine moves in any direction away from the balanced erect stance, the direction and extent of movement varies at various segments of the vertebral column. The direction of movement is determined by the plane of the posterior joints (facets), and the extent of motion is limited by the joint capsules, intervertebral disks, ligaments, and muscles. (Fig. 2).

Movement of the lumbar spine is essentially that of flexion-extension with little or no lateral motion or rotation. Forward flexion consists essentially of slight reversal of lordosis with some degree of excessive lordosis possible with hyperextension. The direction of motion of the lumbar spine is determined by the vertical sagittal plane of the posterior articulations (facets), which are in complete approximation on extension allowing no lateral or rotatory motion.Slight forward flexion, which is reversal of lumbar lordosis, permits the posterior facets to separate, thus allowing some lateral and rotatory motion.

The adult thoracic spine has little or no alteration of the physiological kyphosis in forward flexion or extension. The plane of the facets denies this motion but allows lateral rotatory movement. Thus the vertebral column on lateral and rotatory motion moves essentially in the thoracic area. As the ribs attach and articulate with the thoracic vertebrae, they also exert some limitation



(Fig. 2) From Hugo A. Keim, Clinical symposia vol. 30, 1978.

of motion and range. Because of their attachment, when there is abnormal motion or curving of the thoracic vertebrae, as in scoliosis, the ribs are simultaneously curved to assume an abnormal motion and position.

The cervical spine has movement from the occiput to the first thoracic vertebra in all directions of flexion, extension, bilateral rotation, or combinations thereof. When viewed laterally the head should be held directly above the plumb-line center of gravity, thus avoiding the "forward head posture" and excessive dorsal kyphosis, or "round back.".

The intervertebral disks constitute approximately one quarter of the length of the vertebral column and function as hydraulic shock absorbers permitting compression and distortion. In their torsion facility they allow flexion, extension, rotation, or combinations of these motions. The disks are essentially mucopolysaccharide gelatinous tissue consisting of a central mass, the nucleus, contained within an elastic container, the annulus.

The annulus fibers connect around the entire periphery of the vertebral end-plates and intertwine at approximately a 30° angle. By this arrangement, flexion, extension, and rotation motion is permitted and simultaneously restricted. The nucleus, totally contained within the inner fibers of the annulus and between the opposing

vertebral end-plates, is placed under pressure. The intradural pressure of the annulus is approximately one atmosphere (15 kg/cm^2) and is partially responsible for the elongation of the vertebral column, its length, its flexibility, and maintenance of the ligamentous tension that supports the column.

External pressure exerted upon the disk compresses it, causing deformity and allowing the vertebral bodies to approximate. Release of the external pressure allows the internal nucleus pressure to again separate the vertebral end-plates and restore the vertebral column length and physiological curves. Flexion or extension forces deform the nuclei, but release restores the erect curves. The deformation of the nucleus is compression with maintenance of its cubic content. The annulus "bulges" peripherally.

Attrition of aging and repeated stresses cause dehydration of both nucleus and annulus with fragmentation of annulus circumferential fibers. The vertebrae approximate and the longitudinal ligaments become slack. Asymmetrical degeneration of the intervertebral disks can occur, resulting in abnormal alignment of the vertebral column.

In the posterior aspect of the functional units of