

ENTROPY AND THE GRAVITATIONAL FORCE IN THE SPINAL COLUMN

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Abstract

Spine column have the same way of development like the Universe it self. Our thoughts were that we need to change a clinical approach to the spinal problematic and try to understand spinal disorders from another perspective. That „orbital mentally cross“ is necessary for getting new insight of spinal disorder development. This paper is new clinical angle and new way of approaching to the spine disorders thematic.

Keywords: spine / macro system / micro system / the gravitational force

Introduction

Entropy (Greek *ἐντροπή*, “turn inward”), introduced by Rudolf Julius Emanuel Klauzijus 1865; sheet size that can be viewed as a measure of “related” material energy of a closed system, ie. energy, which, in contrast to “free”, it can not be converted into work. The opposite term is ectropion. From Boltzmann (Lectures on the principles of mechanics, in 1897. until 1904) entropy in the sense of “kinetic theory of gases” means the heat content of a system as the energy of motion of its molecules.

Entropy is the tendency of the system to spontaneously go into greater balance disorder, ie, entropy is a measure of disorder of the system. The largest arrangement of the system temperature is absolute zero. Since it can not be reached, the third principle of thermodynamics (Nernst theorem) is taken to be the entropy asymptotically approaches zero when the system temperature approaches absolute zero. All spontaneous processes (development of the organism as a whole) are taking place in the direction of increasing entropy.

According to the second law of thermodynamics, the entropy of a closed system can only increase to a maximum and remain constant. This means that the system becomes more chaotic over time and less useful/stable with respect to the extraction of useful work from the system, ie. functioning the regularity of vertebral column in its entirety.

Entropy (ENT) as a measure of that amount of disorder of the system, can according to the above considerations be seen as the pursuit of the body or system to be developed and transferred to a new higher state of disorder. Without it, certainly there is no development, nor the formation of life, planets, galaxies, and even spinal system ie. spinal column. On the other hand, if the spinal system developed without control or, if the entropy takes place very quickly (uncon-

trolled process where $G_f \ll Ent$), then quite certain ability to form a system of spinal disorders and deformities. A factor that largely controls the entropy, is the force of gravity (G_f). Without its influence, entropy would completely “destroy” any structure, and vice versa.

Therefore, we can assume that the underlying spinal disorders: kyphosis, lordosis and scoliosis, are a kind of uncontrolled forms of entropy.

To be more specific, kyphosis and lordosis are entropy in 3D (two space and one time dimension) or sagittal plane, and scoliosis is disordered system in a 4D (three space and one time dimension) and is the most severe form of spinal deformity. Scoliosis are divided into functional and structural types. According to this division, the entropy can be similarly classified. Functional scoliosis are less disorganized while structural scoliosis represent a high level of entropy.

The development of the healthy human body and the spine represent the interplay between the (equilibrium) of gravity and entropy. In general, normal growth and development of the spinal system, ie. his aspiration for development, “is controlled by” the force of gravity, which by its nature tends to “infiltrate” into the center of the structure, and thus controls the level of “non - orderliness” of the system.

Without the opposing forces, gravity would quickly summarized vertebral body into a “black hole” of small diameter. In this context, the emergence of hemivertebrae can be viewed as the product of the gravitational effects of strong force that entropy could not overcome completely. This deformity is an imbalance between the force of gravity and entropy in favor of the first.

However, in case of the normal development of the vertebral body, the pressure acting outwards and undermines the gravity force, preventing collapse and thus keeps the body in the normal morpho-functional frame.

The pressure which “rescue” the vertebral body from collapse, originates from the entropy of osteogenetic forces and processes that take place within this structure, causing the movement of particles within the core with the tendency away of the body from the center (with a minimum level of entropy), maintaining this structure in equilibrium.

These reactions produce the energy needed to increase the entropy and energy to overcome gravity. Growth and development of the vertebral body requires large amounts of energy to counter the force of gravity and enable smooth development of the above structure. In addition to this, the forces with different origin (compression, torsion, shear) also hinder the proper development of the body of the vertebrae and other spinal systems.

But we are talking about primarily controlled or positive entropy (when the spinal body develop inside of healthy zone) and, when the gravitational force follows the increase of entropy with the level of organization which don't disturb the spinal system.

When we talk about the forces mentioned above, we have to accept a start from two assumptions:

- First, the extent to which the force of gravity overcomes the entropy, the entropy measure will be expressed and,
- Second, the force of gravity can proportionally affect the entropy and vice versa.

Division of entropy in the spinal system

First of all, the manifestation nature of entropy may have a positive or negative effect on the spinal system. Let us to explain this statement.

Assuming that uncontrolled or negative entropy prevents the proper development of the spinal system (balance between state where $G_f \approx Ent$ - positive effect of entropy), we can in principle agree to the following:

Entropy with low level of disorganization allow proper development of the spinal system as a whole, without adverse effects on the structure and function of the spine; Entropy of this the degree are correctible and successfully controlled by regular preventive exercise. However, if we find that the entropy is uncontrolled and threatens the proper development of the spinal system ($Gf < Ent$ - negative entropy effect), then we are talking about the following structural and functional disorders and therefore suggest two divisions:

- Entropy with low and moderate degree cause: rapid growth and development of the spine, creating (enabling) conditions for the development of general or local muscle imbalance between agonists and antagonists, which have resulted in the formation of kyphotic, lordotic and mild form of scoliosis (a disorder in 2+1D and 3+1D plane);
- Static instability of the spinal system as a whole or certain spinal unit, jeopardizing the proper functioning of the morphological structure and to a lesser extent. Control and correction of these disordered systems it became possible with remedial programs specific orientation to a greater extent or completely (depending on the degree of disorder of the spinal system). This form of entropy is manifested mainly in the pre-puberty and puberty period.
- Entropy of a large degree, cause: Uncontrolled growth, development and behavior of the spinal system allowing the development of general or local muscle imbalance between agonists and antagonists of the spine and causing severe forms of kyphotic, lordotic and scoliotic spinal type. Entropy of this type can be reduced only by surgical intervention.

Compression force and entropy of intervertebral discs – IVD (discus intervertebralis)

With morpho-functional aspects, the intervertebral disc is a specific spinal body which is permanently under the influence of compression, torsion, rotation and shear forces in greater or lesser form, and as such, the body has a complex role in the spinal system. The text below will explain the relationship between compression force and entropy of IVD.

When the compression force minimum, we can say that there is a positive effect of compression force and the entropy of the IVD, which is reflected in the following:

- Low intensity compression will have a low entropy, with minimal level of system disorder, enabling a proper and smooth functioning of the (development) of the intervertebral disc (balance between $Cf \approx Ent$ - positive effect of entropy). These forces at this level produce positive adaptive changes that result with proper functioning (and development) of IVD.

However, increasing the intensity of compression force (CF) overIVD, proportionally to the IVD load, increases the entropy of this system. In this case, we are talking about the negative effects of compression forces that are reflected in the following:

- Compression of low intensity forces can cause the condition of lower level system disorder, in which we have form of fibrous transformation, delamination, micro cracks, Brown's little colorization, etc. The initial degenerative changes in the disc were observed. It is necessary to unload the affected spinal unit to minimize entropy. In such a situation, it is necessary to establish stabilization of spinal system (most vulnerable spinal unit are documented at the level of L4 - L5 - S1). Also important is to constitute a spinal muscular endurance exercise program which will have positive effects at lumbar - abdominal level with proper lumbo-pelvic rhythm and functionality.
- Compression force which causing moderate intensity may provoke moderate degree of system disorder characterized by bulging states of IVD with larger annulus rupture and delamination (mainly by torsional force) with visible migration of the core

content of the IVD (mainly in the posterior - lateral part). In this category are possible higher IVD protrusion with mild lesions of neural structures (mild and moderate radiculopathy types). Visibly detectable degenerative changes of the disc (rim lesions, radial fissures, large-type calcifications, fractures epiphyseal plate - moderate type, etc.). In some cases, surgical treatment is recommended to relieve the affected spinal unit and minimize entropy. In such cases, it is necessary to provide spinal stabilization exercises.

- Compression force with high degree of entropy produce great disorder and chaos in spinal system with a massive extrusion and sequestration of IVD nucleus into the spinal canal, disturbing the structure and functionality of the IVD in posterior - lateral and central direction creating lesions of neural structures and functional loss. This clinical picture marks the high level of vulnerability of the spinal unit and its functionality, static instability, advanced process of IVD degeneration, changed spinal bodies and facet joints and also partial or general physical vulnerability in terms of normal locomotor function (movement). Regulation (stopping) the entropy of such motor - functional loss is possible only with individually designed exercises and surgical interventions in special cases.

References

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