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THE ACTION OF VIBRATION ON THE HUMAN BODY WITH THE SPINAL COLUMN REFERENCE

Acxel Emil FARCAŞ, Mariana ARGHIR

Abstract: *The paper presents a documentary study concerning the action of vibration on the body, but with the focus on spinal column. Through this paper identifies sources of vibration and drive module on the human body. This paper is part of a study into what action the vibration on the human body, a system of transport, which affect the spinal column in vertical position, and in a sitting position.*
Key words: *vertical vibrations, human body, spinal column.*

1. GENERAL CONSIDERATIONS

The human body is subjected to the action of vibration in machines with moving and vibrating along with them, when man is in the rooms, which are in operation, or when machinery and equipment over certain parts of the human body is acting directly to low-frequency vibrations produced by portable vibrating machines. The main areas in which it is felt the presence of vibration:

- Industry;
- Constructions;
- Transports;
- Agriculture.

A). The short-term exposure to vibration in the field 2-20 Hz, resulting in the appearance of the following symptoms: abdominal pain, discomfort, malaise, headache, chest pain, nausea, loss of balance, muscle contractions and decreasing the accuracy of execution of maneuvers, breathing slow, ponderous speech.

B) The long-term exposure can lead to health problems, particularly problems of spine: herniated disc, degenerative changes in the column under lumbar scoliosis, diseases of the spinal discs, degenerative diseases of the spine, the disc displacement, diseases of the gastrointestinal system, and diseases of uro-genital system [Abe 07].

2. THE EFFECTS OF VIBRATIONS ON THE SPINE

Resonances occurring between 4 and 6 Hz, as well as between 10 and 14 Hz, suggest combinations mass-spring consisting of:

1) Completely along the trunk bottom of spine and with pelvic belt,

2) Upper torso with movements of bending toward the front of your upper spine. Assuming the occurrence of bending of the upper spine is based on observations of the transient response of the body to the vertical loads applied through shock and compression fractures related to them. The highest loading occurs in the area between the 11th thoracic vertebra and lumbar vertebra has two, which may be considered, therefore, surface around which is caused by bending your upper torso.

Because the center of gravity of the bust is far more up the front than the backbone, bending movement will occur even if the force is applied parallel to the axis of the spine (Fig. 1) [Har 69]. This phenomenon is considerably influenced by the change of direction of force, i.e. applying it under a certain angle toward the backbone (e.g. by tilting the torso in front). The same happens in the case of centre of gravity of the head. He may be in the front of the neck, which allows tilting movement of the head in the front and rear [Net 06].

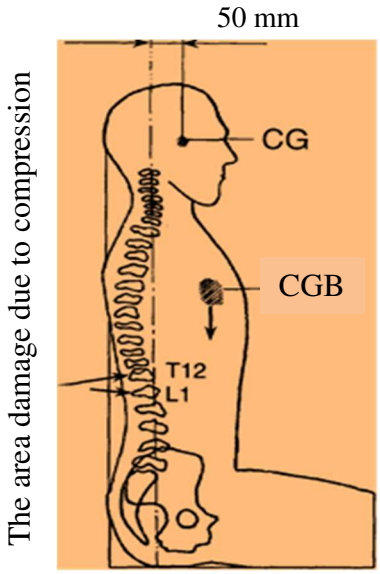

Fig. 1. The position of a seated man with the Centre of Gravity (CG) of the head and of the body (CGB) with portion above the 12th thoracic vertebrae

Vibrations with frequencies of between 2.5 and 5 Hz generates powerful resonance in the vertebrae in the neck and lumbar area and can reach amplification up to 240%; the vibrations between 4 and 6 Hz lead to resonance of the torso, with amplification up to 200%, while the vibrations of 20 to 30 Hz causing resonance in head-neck area-shoulders, with amplification up to 350% [Har 69].

2.1. Anatomical concepts linked to the backbone

The human body is formed from bony hard skeleton, whose elements are linked by very strong fibrous ligaments and that is wrapped by the muscles and connective tissue.

The backbone, also called spinal column, slightly curved, represents the central structural element supports the upper body and accommodates the most important thoroughfare of breakdown, skete and vertebral deformations have disorders often neurological and track. It is composed of vertebrae, which are basically cylindrical elements, separated by discs with cartilaginous fibers (Fig. 2).

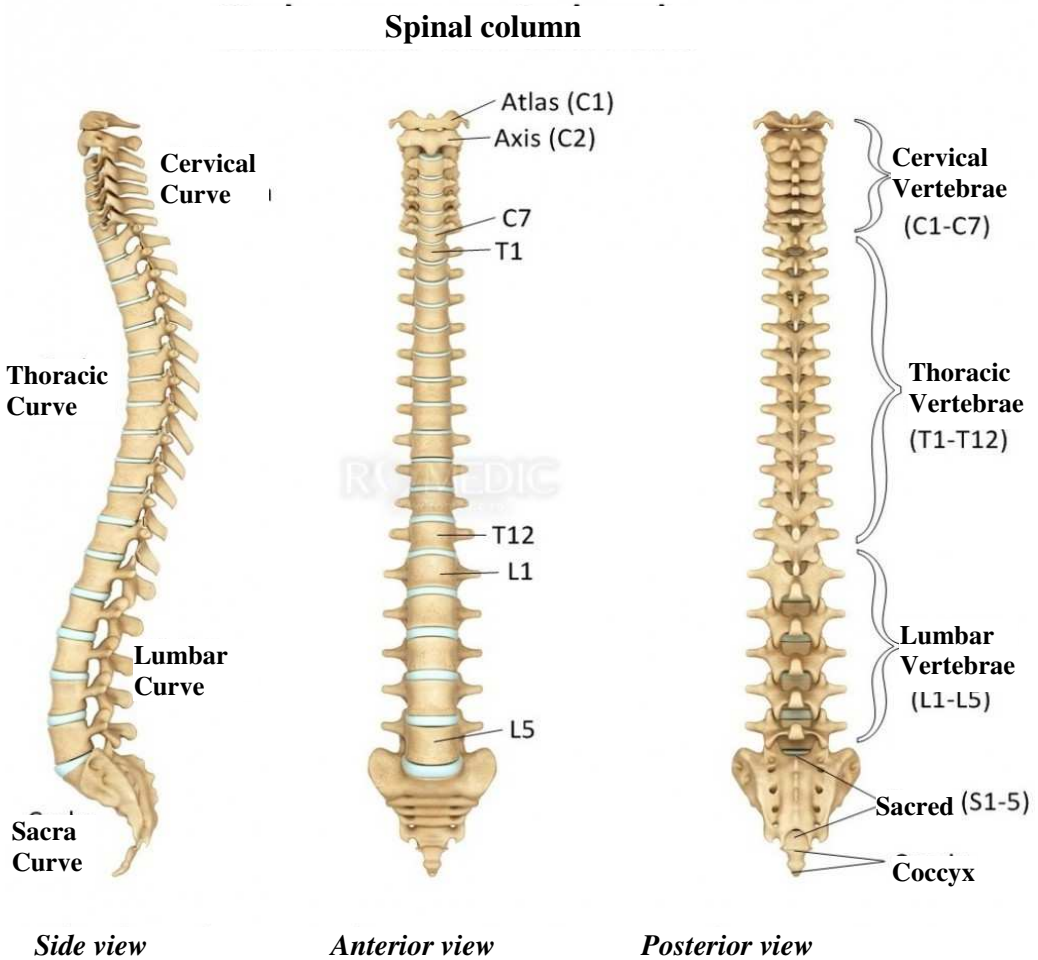

Fig. 2. Regions of the spine with cartilaginous fibers of discs [Net 06]

Part of the locomotor system, the backbone intervenes to support the body at rest and focus, as well as in dynamic, through the multitude of movements that allow them.

The backbone is a complex, with a highly functional importance. It consists of 33-34 vertebrae, 344 articular surfaces, 24 intervertebral discs and 365 ligaments with 730 muscle insertions.

2.2. Mass centre position in the backbone

To calculate the loads to which it is subjected to the backbone, applies the theory of the lever. The column was compared to a balance in which the pointer is the nucleus and arms are those over which it exerts forces.

In order for the balance to be maintained force moments must be of the same value; the forces must be reversed with the length of the lever arms. Knowing the location of anatomical shapes and line the Centre of gravity of the body, can be acceptable, correspond, calculate the force expansion efforts suffered disc and vertebra (Fig. 3) [Net 06].

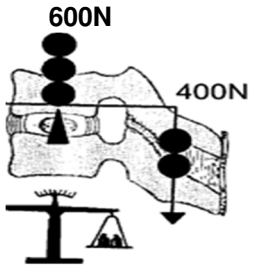

Fig. 3. Levers' theory for a vertebra [Abe 07]

If partial weight of the body, above the T7 vertebra is 200N, the force of extension should be about 400N. Force compression exerted on the disc will be 600 N (Fig. 3).

3. THE PROPORTION OF SPINE LOADING

If the line weight of the body from the fulcrum of the intervertebral disc, the time weight the body increases. Expansion force must grow and it accordingly. Compression efforts suffered disc and vertebral structures can become important.

Loading the spine changes, when the action of vibration over it. Forces will be alternating tensile and compression, but you need to maintain between the same limit, in order to avoid damage of the spine.

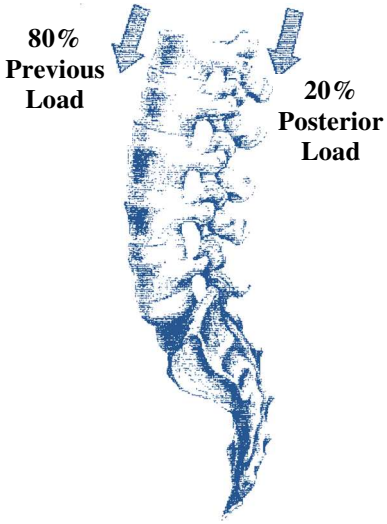

Fig. 4. Proportion of the spine loading

Maximum weight is in the front of the spine, and 80% of the total load, the bodies being those vertebrae which support this load, and the remaining 20% is taken up by the back of the spine (Fig. 4).

Each vertebra, taken separately, presents six degrees of freedom: three rotations on the three axes x, y, z, and three shift on the same coordinate axis of the human body, corresponding to the transverse plane (x-axis), sagital plane (y-axis) and coronal plane (z-axis).

4. CONCLUSIONS REGARDING THE HUMAN BODY VIBRATIONS

A full appreciation of the vibration exposure involves the measurement of acceleration on well-defined directions, frequency, and duration of exposure. Acceleration is measured in three directions: longitudinal (soles, buttocks up to head-direction z) and two transverse directions (from the back toward the chest-x direction and from the right to the left-y direction).

Any vibration acting on the human body, acts over the spinal column, which is the sponsor of the human body position. That is

why the study of the general action of vibration on the human body, refers in particular to the action of vibration on the vertebrae of the spine.

When vibrations appear on several directions at the same time, the effect on the comfort and the effect of compound movements can be much greater than in the case of vibrations in one direction.

Human vibration measurements, values in the most different and varied effects, because they are influenced by a multitude of factors. Because of this, the vibration shall be measured on the axis of the human body x, y and z, taking into account the position of the body, taking into consideration the vehicle's rotation axes (roll, pitch and yaw), the degree of comfort of the means of transport or the technical condition of the running surface, the shutter speed (or occasionally), taking into account environmental factors (noise level. Visual stimuli, temperature and humidity) and activities performed during this time (reading, writing, typing, eating, drinking).

Negative effects of vibration on the human body leading to decreased ability of staff, its performance is reduced by default also may arise against accidents at work.

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Acţiunea vibraţiilor asupra organismului uman cu referire la coloana vertebrală

Rezumat: *Lucrarea prezintă un studiu documentar privind acţiunea vibraţiilor asupra organismului, dar cu focalizare pe coloana vertebrală. Prin lucrare se identifică sursele de vibraţii şi modul de acţionare asupra orgaanismului uman. Această lucrare este o parte a unui studiu în ceea ce acţiunea vibraţiilor asupra organismului uman, intrun mijloc de transport, care afectează coloana vertebrală, în ortopoziţie şi în poziţia aşezat.*

Acxel Emil FARCAŞ, PhD Student, Department of Engineering Mechanical Systems, UTCN, e-mail: axel_farcas@yahoo.com, Office Phone 0264.401.759.

Mariana ARGHIR, Prof. Em. Dr. Eng., Department of Engineering Mechanical Systems, UTCN, E-mail: Mariana.Arghir@mep.utcluj.ro, Office Phone 0264.401.657.