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DOCUMENTARY STUDY ON THE MUSCULAR SYSTEM OF THE HUMAN BODY REQUIRED TO MECHANICALLY VIBRATIONS INDUCED FOR REFACEMENT OF THE ORGAN IN SUFFERING USING ENERGY ANALYSIS

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Abstract: The paper presents the necessary documentation for the energy analysis of the muscular system subjected to mechanically induced vibrations. The material system assimilated to the left shoulder muscles of a human subject is subjected to a torsion vibration. For this, the material system is studied from a constructive point of view, through the mechanical characteristics, the way of interaction with the whole organism. The study of energy consumption is carried out with a medical assembly, which takes over the mechanical demands in the muscles (EMG) and the energy detected by the central nervous system (EEG). The paper presents in detail all the aspects existing in the literature studied and which are necessary to solve the theme of the doctoral thesis, which deals with: the action of mechanical vibrations on the human body from an energy point of view.
Key words: mechanical vibrations [Arg 15], muscular system, energy analysis.

1. INTRODUCTION

The application of vibrations to different parts of the human body, have been used since antiquity. The vibrations applied achieved the fortification of the organ in question, if it was healthy, or the restoration of health, if it was suffering.

In this paper is carried out the documentary study in order to apply vibrations on the muscular system of the left shoulder {Bud 13]. One of the three muscles of the system is strained by an operator, and he twists the muscle. After which, the muscle is left free, and executes free depreciated oscillations. The motion of the muscle will be analyzed with the help of the medical system, which can carry out the analysis on different frequency ranges [Dar 88].

2. PRESENTATION SURVEY OF THE MUSCULAR SYSTEM

Muscle tissue is made up of elongated cells – muscle fibers (Fig.1) containing in addition to the common cellular organelles and specific contractile cellular organelles – myofibrils. They consist of two types of myosine and actin myophyllates [Irs 15].

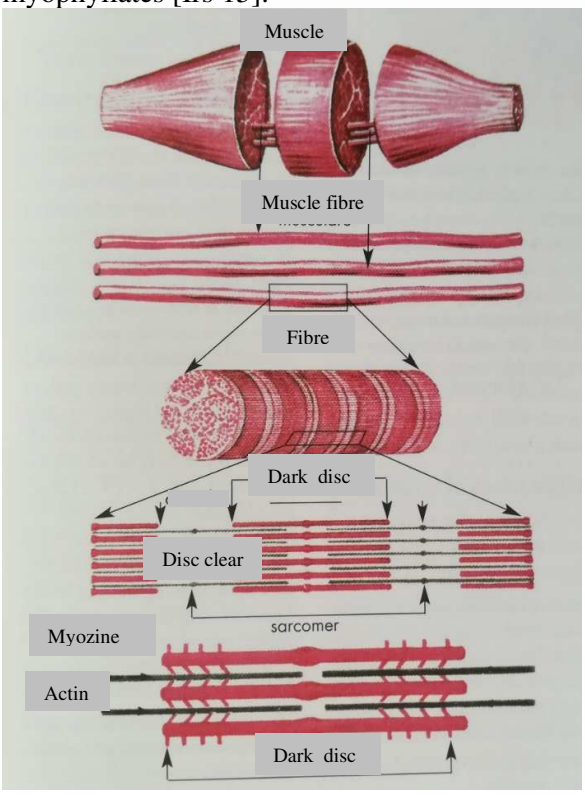

Fig. 1. Muscle tissue structure

After the particularities of myofibrils, the muscles are divided into three categories: skeletal striated muscles, cardiac striated muscles and smooth muscles. Skeletal striated muscles can be operated voluntarily, the cardiac striated muscle although it is a striated muscle has involuntary action independently of the central nervous system, and the smooth muscles are muscles of the viscera with involuntary action.

2.1. Skeletal Muscle System

The skeletal muscular system comprises the skeletal muscles and constitutes the active part, which together with the bone system and the articular structures as a passive part, forms the locomotor system. Skeletal muscles are formed from striated muscle tissue that contracts voluntarily, gives shape and posture to the body.

Skeletal muscles use about 18% of the body's energy, and of the energy used by them 25-30% is used for movement, and the rest is used for heat production [Pap XI].

2.2. Functional Properties of Skeletal Muscles

The skeletal muscles contain the support and positioning part of other organs and organisms of the human body. The skeletal muscular system constitutes the active part, which together **with** the bone system and the articular structures as a passive part, make up the locomotor system [Chis 11].

The properties of skeletal muscles are:

1. **excitability** - the ability to be stimulated, and to respond with the help of the nervous system;
2. **contractility** - contraction, shortening of the muscle;
3. **extensibility** – the ability to stretching of the muscles
4. **elasticity** – the ability to return to the first stat after the cessation of the request (contract or extension);
5. **adaptability** – the ability to respond and modify depending on how you use it.

The muscles are always fixed through a tendon. Tendons are the form of connective tissue fibrous, resistant and non-extensible tissue. Most of the muscles are fixed by their extremities on the bones (hence the name of skeletal muscles), but they can also be fixed to other formations: skins, fibrous membranes, aponeurotic pores in the thick of the regional strips, on intermuscular septum, on the tendons of other muscle, on the mucous membranes, on the cartilages. Of the two extremities of the muscle, one is considered an origin and the other is an insertion, in general the origin is considered the less mobile part and closer to the trunk.

Important observation: If any of these functional properties are affected, the edge is sick, it becomes painful and it needs to be treated. A possible treatment procedure is the "Bowen practice", with which this Doctoral thesis.

2.3. Skeletal Muscles

The skeletal muscles in a succinct representation are shown in Figure 2.

For skeletal muscles there are various situations, cases where the muscles are arranged next to each other, sometimes overlap on the planes. In the interstitials between them are found the fascists that lead the vessels and nerves. Deep muscles cover the joints, and superficial muscles come in relation to the skin through the covering fasces of the respective segments. Some blood vessels enjoy muscle satellites that constantly accompany them. The outer form is the date of the settlement, volume, state of contraction or relaxation of the muscular body [Irs 15].

Figure 2 shows that the muscles can be:

1. long, long, short, circular, radial;
2. with one or more ends;
3. with different orientations towards tendons;
4. depending on the number of joints they pass over;
5. depending on the number of moves made.

In the current paper we will refer to the deltoid muscles as a doctoral study.

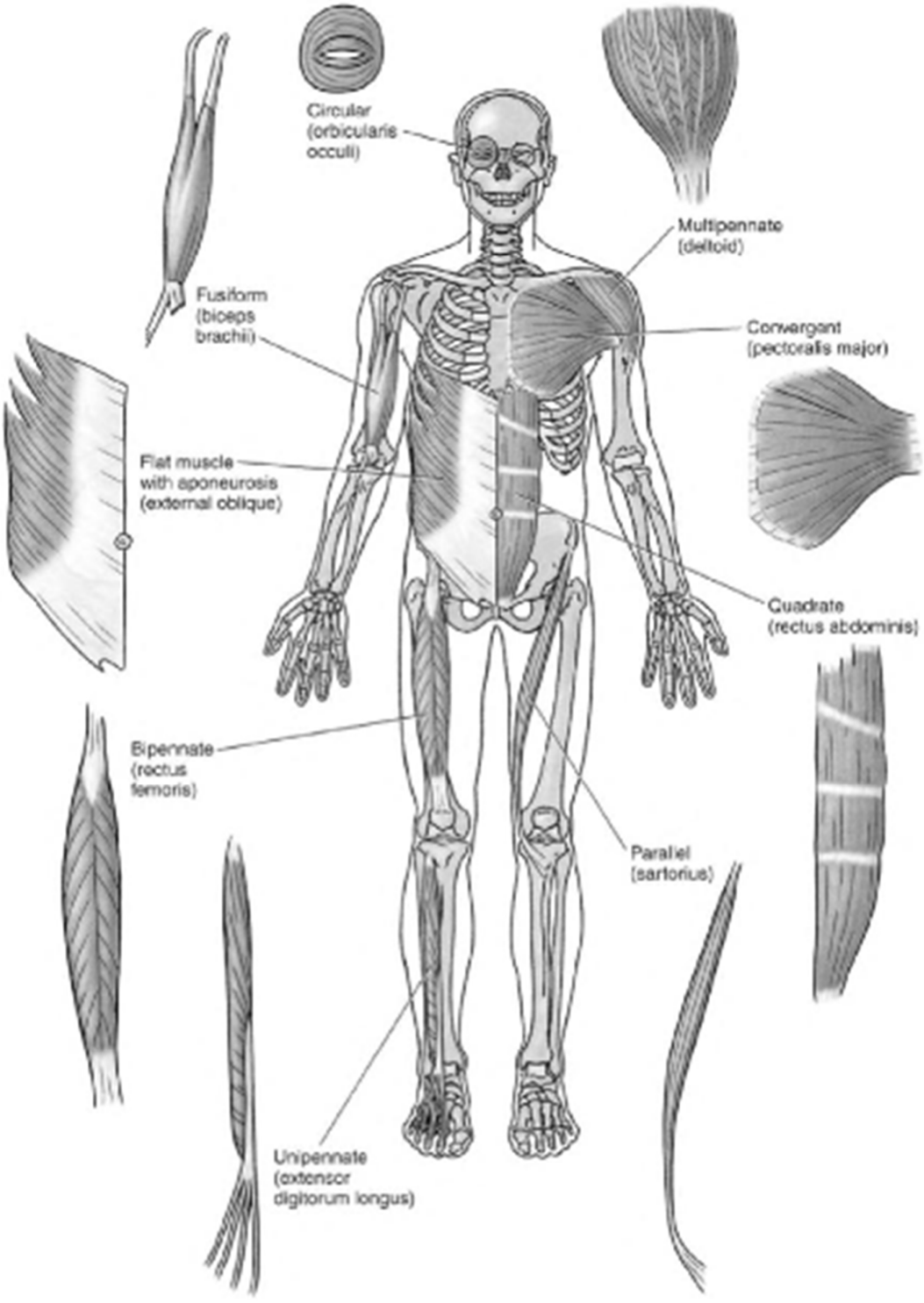

Fig. 2. Skeletal muscles

2.3.1. Shoulder muscles

The scapula-humeral joint has the greatest mobility of all the joints of the body and is also the most unstable. The six shoulder muscles are: deltoid, supraspinous, infraspinous, large round, small round and subscapular [Osc 03a], [Osc 03b].

The deltoid is located on the surface and is the most voluminous of the um shoulder muscles. It is a multipennate muscle, has a triangular form and covers the joint scapulo-humeral (Fig. 3).

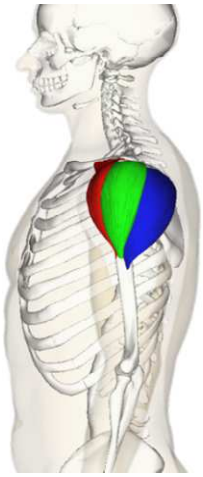

Fig. 3. Anterior deltoid (red), medium (green) and posterior (blue)

The deltoid is made up of three zones: the anterior, middle and posterior deltoid. The inserts shall be corresponding to the three portions of the insertion [Ros 09]:

1. the anterior deltoid originates on the lateral third of the anterior edge of the clavicle by tendinous fibers and muscle fibers;
2. The middle deltoid originates on the lateral edge of the acromion;
3. The posterior deltoid has the origin on the lower lip of the posterior edge of the scapula spine.

All these notions are necessary, because the treatment will be placed on the left deltoid, which is shown in the picture (Fig. 3).

2.4. Muscle Mechanics

The properties of contractility and muscular elasticity are the basis of the movement. Muscle contraction generally occurs as a result of a stimulus received from the central nervous system through motor nerves. Other stimuli can be mechanical, electrical or chemical.

The deltoid muscle through its three portions achieves the following movements:

- previous beams execute the forward projection and internal rotation of the arm;
- the middle is exclusively abductor;
- the rear beams achieve the rear projection and the outward rotation of the arm.

3. THERAPEUTIC ACTION

Bowen therapy is a method of stimulating the body to regain the maximum capacity for self-regulation and self-healing [Osc 03b].

The Bowen technique constitutes a wise reset of the organism because it is in perfect agreement with its homeostasis mechanisms of functioning: challenge-rip.

At any change in the external and/or internal environment, the body has the capacity to be responsible for keeping the parameters of the system within vital limits. This is carried out through a multitude of homeostasis mechanisms (self-regulation) at both physiological and psychological levels.

In fact, more than 95% of the body's growth-development, adaptation and defense mechanisms are guided by the autonomic nervous system. Homeostasis is **a natural, vital = without capacity from which biological life would not be possible**, specific to complex systems, developed throughout evolution, and almost all homeostasis mechanisms have developed on the challenge model – repost, in response to an external or internal stimulus.

The therapist launches a specific stimulus (challenge) that causes the body to process it and generate a feedback. In most cases, the general reaction (feedback) consists in reducing stress hormones in the system, because the parasympathetic component of the autonomic nervous system is activated, which leads to deep relaxation.

3.1. Therapeutic Movements

Bowen therapeutic movements applied in the shoulder procedure consist of the following aspects. The shoulder procedure is applied to both the left shoulder and the right shoulder,

with the mention that it is first applied to the healthy shoulder, or if there are disorders of both shoulders, then it begins with the one who presents a more mobile joint.

The patient is seated in the sitting position on the chair with his back straight glued to the seat back.

The therapist supports the arm and forearm (between the two angles being 90 degrees and the forearm parallel to the ground) corresponding to the shoulder is applied to the shoulder in a slightly lateral position towards the trunk at an angle of 15 degrees, to highlight the posterior beams of the deltoid muscle.

1. The medium and ring shower fingers come into contact with the skin that covers the posterior portion of the deltoid and together with it moves obliquely, without slip from the forward to the back perpendicular to the posterior edge of the muscle passing over it and penetrating under it in depth with the peaks of the fingers, all without slip on the skin, trying to catch, to unwrap fascia that dressing the posterior beams of the deltoid and causing it in the face of it as much as possible. There is an intentional deformation of the stretch of the fascia that constitutes the challenge for the muscle and joint. The challenge is maintained for 2-3 seconds, followed by a firm call for torsion over the posterior edge, also without to slip on the skin (Fig. 4).

Fig. 4. Deltoid oblique displacement

2. The torsion movement, the oblique elbow joint moves towards the ear opposite the shoulder on which the procedure is applied. The movement is as extensive as the mobility of the joint allows. Once reached the maximum amplitude, the arm remains fixed for a few seconds, during which a small shock is transmitted to the joint by a slight blow to the shoulder, in the direction of the two shoulders and in the opposite shoulder direction (Fig. 5).

Fig. 5. The second motion

3. The third movement consisted of the return of the arm to the initial position to 15 degrees laterally to the torso, after which we move the skin in the same way, but this time with the fonts perpendicular to the edge of the anterior fascia of the deltoid, enter under it, request fascia at the stretch and then by a slow displacement slow this time, execute a request to torsion over each anterior beam , without to slip on the skin, as much as its mobility allows us (Fig. 6).

Fig. 6. The third motion

The mechanical movements presented in the sequence are necessary in the application of Bowen therapy, for highlighting the energy factor, which is developed by the body through amortized local vibrations, which occur as a result of requests [Arg 15].

The energy variation is highlighted with a specialized medical equipment, which will be presented in the next chapter.

4. BIOMEDICAL MEASUREMENT SYSTEM KL – 720

To highlight the action of vibrations on the human body and to establish their energetic influence, the Bowen technique will be applied. Measurements will be made before, during and

after treatment, followed by the new ub set of measurements at 7 days after the previous treatment session, following the same sequence. Measurements will be performed with KL-720 Biomedical Measurement System, produced by K&H MFG CO., LTD Taiwan [KL-720].

The equipment is designed to experiment with basic theory and perform physiological measurements. The apparatus contains 9 modules for measurements including:

- Electrocardiogram (ECG) – electrical activity generated during the heart rate,
- Electromyogram (EMG) – changes in electrical potential during muscle activities, including isotonic or isometric contractions,
- Electro-oculogram (EOG) – electrical variations of the eye muscle during eye movements and measurement of the electrical potential of the eye muscles,
- Electroencephalogram (EEG) – measuring brain activity,
- Oscilometric blood pressure measurement,
- Photoplethysmogram measurement,
- Respiratory ventilation,
- Pulse variations,
. Detection of body impedance.

The study carried out within the doctoral thesis will be highlighted by two modules of the KL – 720 part, in order to realize: Electro-myogram (EMG), and Electro-encephalogram (EEG).

4.1. General description of the system

The system used is composed of a central unit and modules specific to the 9 tests / measurement that can be carried out with this apparatus, and they can be connected to the central unit (Fig. 7).

The system is equipped with microprocessor for the conversion and processing of biomedical signals. The working frequency between 6 and 100 Hz will be used, specific to the behavior of the human body under the action of free vibrations.

Fig. 7. Biomedical measurement system KL-720

4.2. Electromyogram (EMG)

The electromyogram will study the variation in the potential for action and what is happening energetically when applying the Bowen

procedure to the left shoulder, more specifically on the left deltoid muscle. This can be achieved using the KL-72001 central unit and the KL-75002 electromyogram, body surface electrodes, an oscilloscope and other necessary accessories (Fig. 8).

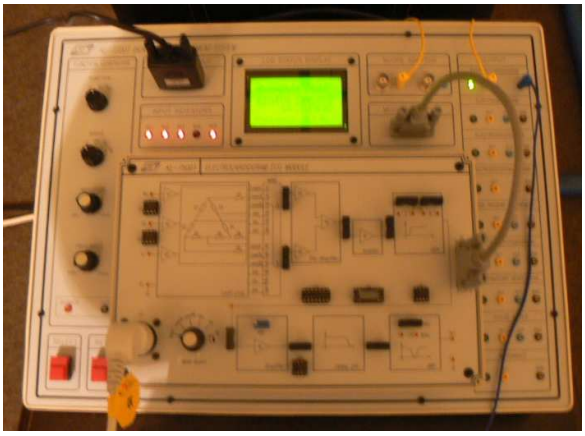

Fig. 8. Mounting of the KL-720 system for electromyography

In the procedure on the shoulder, with the muscles in a state of relaxation, will take place the launch of a stimulus through a vibration induced posterior deltoid, a small shock and another vibration on the fascia of the anterior deltoid. By using three electrodes applied /mounted two on the origin and insertion of the deltoid, and the third in contact with the other shoulder over which no action will be exerted (Fig. 9).

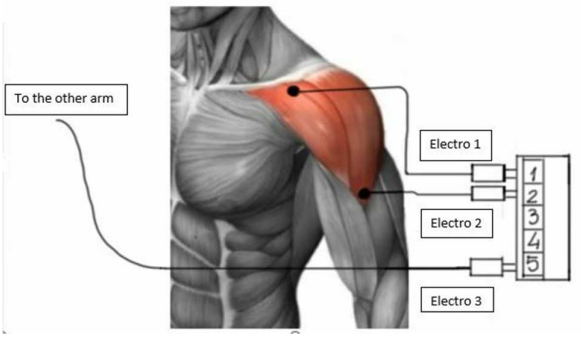

Fig. 9. Mounting electrodes

Six different signals will be measured, which will be recorded in the Central Unit of the computer, according to the specialized software. Their analysis corresponding to the sequence of measurements, will determine the energy intake of the application of the Bowen procedure on the edges of the shoulder.

4.3. Electroencephalogram (EEG)

The second grouping of measurements is performed with the electroencephalograph, when the same movements are performed on the deltoid, as in the previous paragraph.

The positioning of the electrodes is shown in Figure 10. Six different signals will be recorded for each measurement performed in the sequence of the three movements, in line with figures 4, 5 and 6.

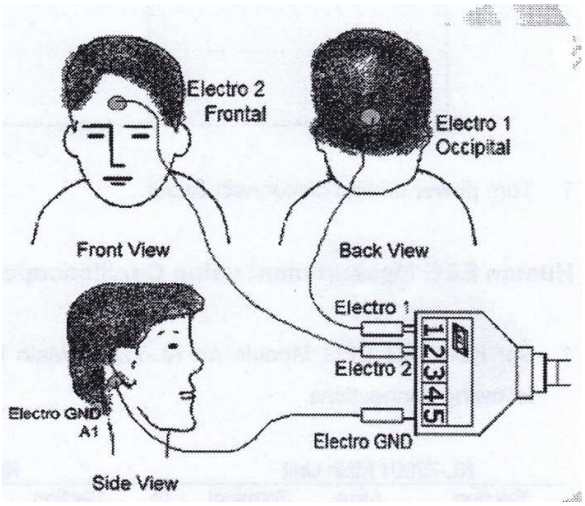

Fig. 10. Positioning of electrodes for electroencephalogram

5. DISCUTIONS. CONCLUSIONS

The work constitutes a first phase of study/ documentation on the muscular system with a focus on the shoulder muscle, especially the deltoid muscle on which the procedure for the left shoulder used in the Bowen technique will be applied.

Stimulations launched by the therapist through vibration movements induced by posterior and anterior deltoid muscle strips will be analyzed using the apparatus presented in the paper, by two measures that can give us clues about what is happening at the energy level in the muscles and in the system.

The two measurements will be the EMG-electromyogram with strictly muscular records

of the deltoid and the second EEG-electroencephalogram on the muscle that could give us clues about the electrical brain activity in the system, the system being here the human body.

This stage is a necessary one and prepares the experimental stage, part of the doctoral work with the thesis: "Influence of Mechanical Vibrations on the Human Body from an Energy point of view".

6. REFERENCES

[Arg 15] Arghir M, *Mecanica Fundamentală Noţiuni de Bază, Principii şi Teoreme*, U.T. Press 2015

[Bud 13] Budescu E., *Biomecanica Generală*, Iaşi 2013

[Chis 11] Chiş I.C. and Simedrea R.A., *Fiziologia Organismului Uman vol. 1,* Casa cărţii de Ştiinţă Cluj-Napoca, 2011

[Dar 88] Darabont Al, at al, *Şocuri şi vibraţii Aplicaţii în tehnică,* Ed. Tehnică Bucureşti 1988

[Irs 15] Irsay L and Popa A., *Anatomia aplicată a aparatului locomotor*, Ed. Medicală Universitară "Iuliu Haţieganu" 2015

[KL-720] Biomedical Measurement System KL-720, K&H MFG Co, LTD

[Mor 80] Moraru S, Lascu O., *Electricitatea Atmisferică şi organismul uman*, Ed. Medicală, Bucureşti 1980

[Osc 03] Oschman J, *Energy Medicine The Scientific Basis*, Second edition 2016, Elsevier Science, USA 2016

[Osc 03] Oschman J, *Energy Medicine in Therapeutics and Human Performance*, Elsevier Science, USA 2003

[Pap XI] – ediţia a XI – copyright 1993, 1998, 2001, 2003, 2006, Papilian V, *Anatomia Omului vol I Aparatul Locomotor,* Ed. Bic All

[Roş 09] Roşu Ionel et. al (2009), *Enciclopedia corpului uman,* Bucureşti, Corint

STUDIU DOCUMENTAR ASUPRA SISTEMULUI MUSCULAR AL ORGANISMULUI UMAN SOLICITAT LA VIBRATII INDUSE MECANIC, PENTRU ANALIZA ENERGETICA

Rezumat: Lucrarea prezinta documentatia necesara in vederea analizei energetice a sistemului muscular supus la vibratii induse mecanic. Sistemul material asimilat muschilor umarului stang al unui subiect uman este supus unei vibratii de torsiune. Pentru aceasta se studiaza sistemul material din punct de vedere constructiv, prin caracteristicile mecanice, modul de interactiune cu intregul organism. Studiul consumului energetic se realizeaza cu un ansamblu medical, ce preia solicitarile mecanice in muschi (EMG) si energia sesizata de sistemul nervos central (EEG). Lucrarea prezinta in detaliu toate aspectele existente in literatura de specialitate studiata si care sunt necesare solutionarii tematicii tezei de doctorat, care se ocupa de: actiunea vibratiilor mecanice asupra organismului uman din punct de vedere energetic.

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