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EXPERIMENTAL STUDY OF THE EFFECT OF VIBRATION ON THE HUMAN BODY FROM A THERAPEUTIC PERSPECTIVE

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Abstract*: In the paper to make a study of the action of vibration on the human body, through which it aims to establish the therapeutic effect. Experimental study of vibration highlight action by putting in evidence of electrocardiography of four subjects to which investigations are made in three stages. In the first stage are performed an electrocardiogram before the application of vibrations, the second stage is when it acts the vibrations on the body produced by a vibrating platform, and the third stage is registered the EKG after removal of the source of vibrations. The results of the investigations highlight the possibility of therapeutic effect.*
Key words: *experimental study, therapeutic effect, human subject, vibrations.*

1. GENERAL CONSIDERATIONS

This experimental study is trying to establish how the heart, with has a vital role in blood circulation, respond to requests through vibrations. For this purpose it is studying by applying electrocardiograms, answer the heart vibrations and the properties of the cardiac muscle put in evidence.

1.1. Properties of the Cardiac Muscle

Generally the cardiac muscle has the properties:

- **Excitability:** It is owned by the myocardium to respond at stimuli that maximum equals or exceeds of the «threshold». The heart is excitabilă only in the phase of relaxation (diastole), and in the systole it is in absolute refractory and it not respond to stimuli. This represents the "periodic law of not excitability".
- **Automaticity** is the property of nodal tissue to rhythmic excites himself. The mechanism is based on cyclic changes of depolarization and repolarisation of the membrane of them cells.
- **Conductivity** is the property of myocardium of promoting the excitation in all its fibbers. Automatically generated impulses of the sinoatrial node rhythmically and spreads in the walls of the atria, get into the atrioventricular node and through the His beam and the Purkninje network, at the ventricular myocardial tissue. Nodal tissue generates and conducts impulses, and adult tissue infarction respond by contractions.
- **Contractibility** is the property of the myocardium to respond to a stimulus action through changes in the size and voltage. Thus, in the heart of a pressure on blood content and its expulsion. The force of contraction is greater in the ventricles than in atria, and why is the left ventricle. The atria contractions are called systole and relaxations are called diastole.

1.2. Electrocardiogram in Solicitations Response

Electrocardiogram is noted with ECG or EKG and is a recording of the electrical activity of the muscle fibers of the heart. Each contraction of the myocardium is the upshot of an excitation, which originates from the sinus node and is transmitted to the heart muscle. These changes in the electrical potential of the heart can be measured at the surface of the body, being presented by a repeated image of cardiac electrical activity. Using electrocardiogram they

can state a number of properties, and diseases of the heart.

This activity is recorded on the surface of the body with the help of 4 electrodes attached to the distal ends of the upper and lower limbs. The four wires are color coded (red, yellow, green, black) + noted (with R/RA = right, L/LA = left, LF = left leg, RF = right leg). The 4 electrodes on the inferior members shall correspond to 6 derivatives on EKG: bipolar 3 (composed of potential difference- negative pole/positive pole – from measurement of 2 wires) and the 3 individuals (formats using a couple of electrodes as negative pole and a third electrode as the positive pole). The records shall be carried out with the help of electrocardiograph, which contains a system for collecting the electrical potentials of the hard level, a unit of amplification and an enrollment system for graphics display.

2. EXPERIMENTS DESCRIPTION

To perform the experiment used the biomedical KL-720 system for measuring in the electrocardiogram procedure (Fig. 1.)

To perform the experiment used for measuring biomedical system KL-720 (fig. 1.)

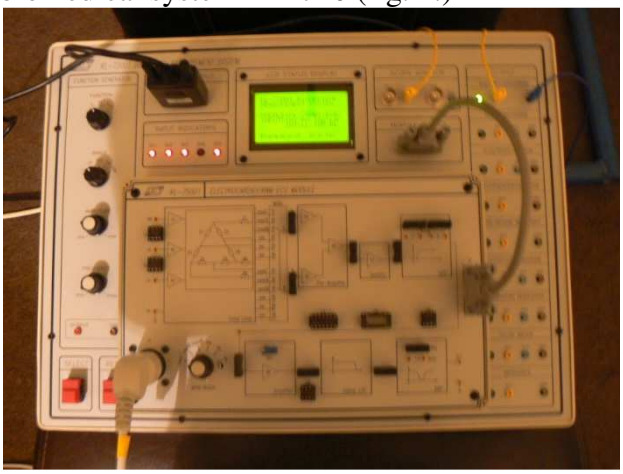

Fig. 1. Mounting system KL-720 for electrocardiography, which contains: background plate, on which is mounted the ECG module

The vibrating stimulus was given by the platform (PV) Body Sculpture BM1500 Power Trainer. BM1500 consists of a platform driven by a motor with eccentric commissioned by the control panel. To simplify things we resorted to laying a stable support on the vibranting board.

4 subjects were tested between the ages of 37 and 68 years, both women and men. Noting that the subjects are people who are engaged in daily physical activity, just the two of them do physical exercise every day.

On every subject were performed 3 sets of metrics:

- the first measurements were made before submission to vibrations;
- the second measurements were made when the subject was subjected to vibration on the plate of the vibrating platform;
- the third measurements was made after the subject was placed on a chair, without vibrations.

2.1. Application of electrodes on the operator

For obtaining the electrocardiogram registration is necessary to apply the electrodes on the operator – on the human subject subjected to vibrations for them influence over the human body. The electrodes application is given in the Figure 2.

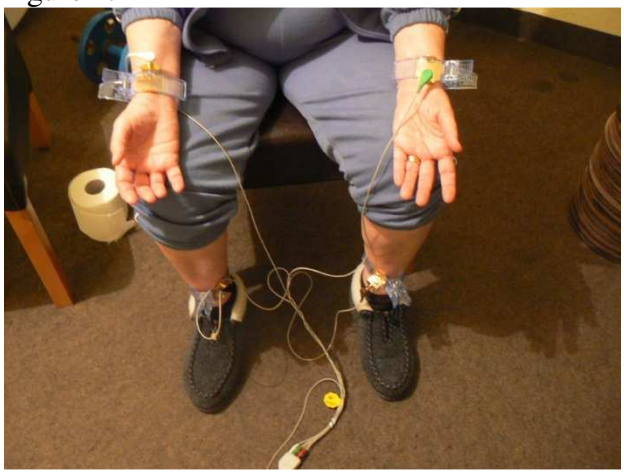

Fig. 2. The electrodes application on the subject

2.2. Subjects structure subjected to the experiment

For subjected to vibrations, the subjects were information about the procedure and they have agreed, what will be done by this experiment.

Group structure subjected to investigations is found in table 1.

Tabel 1.
Subjects structure for the experiment

No. of subject	Sex	Age	Height	Weight
Subject1	M	37years	1.78 m	88 kg
Subject2	F	38years	1.71 m	64 kg
Subject3	M	42years	1.83 m	85 kg
Subject4	F	68years	1.57 m	64 kg

2.3.Capture Software for Electrocardiogram

Biomedical system KL-720 is a complex system for medical investigation, it has nine measurement modules, and one of them is for electrocardiogram measurement. It is given in the Figure 3.

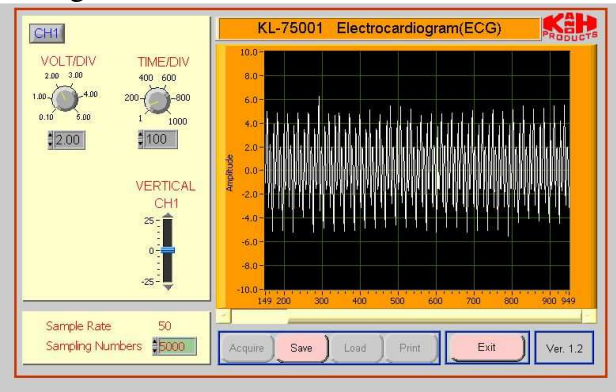

Fig. 3. The software interface of the signal capture of the system's EKG KL-720, ECG module noted KL-75001

Cardiac activity is measurementedbefore, during and after submission of the body to a vibrator frequency stimulus 22 Hz sinusoidal signal as indică of the măsurat apparatus, after as can be seen in Figure 3.

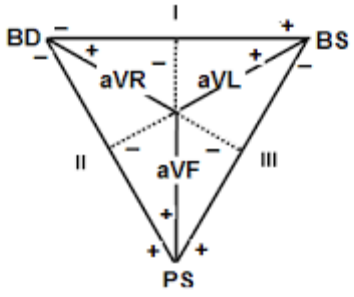

Fig. 4. Significance of applying electrodes on a human subject, according to the triangle's Einthoven for achieving ECG measurement

Measurements on ECG are based on three bipolar leads (Lead 1 BD, Lead 2 = BS, Lead 3 = PS) introduced in practice of deep Dutch physiologist Einthoven and represents an equilateral triangle with the heart in the centre.

At them they can add the unipolare leads (aVR = right hand, aVL = left hand, aVF = right lag, is considered reference becouse it is more distant from the heart).

3. EXPERIMENTAL MEASUREMENTS

3.1. Before the Request from Vibrations

Before the request from vibrations, each topic has been applied to the electrodes (Fig. 2). It shows in succession the six recordings for each person investigated.

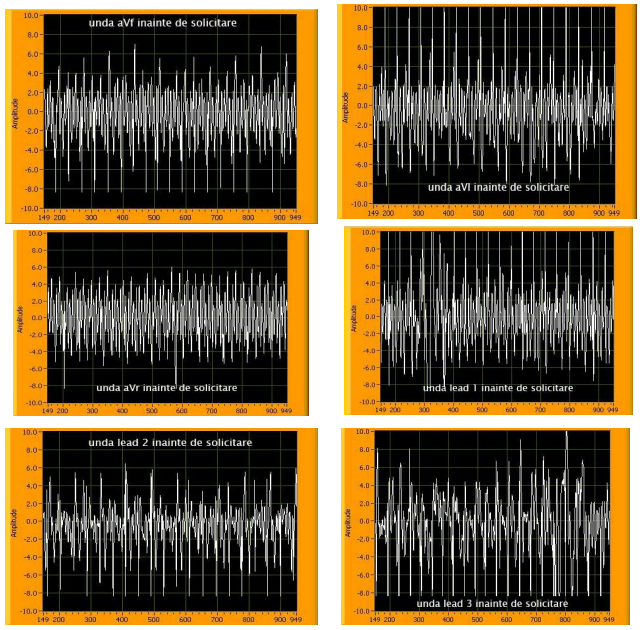

Fig. 5. ECG measurement before requesting to vibration for subject1

The representations from Figure 5 regarding the first human subject under investigation, it appears that has a normal electrocardiogram, the myocardium functionless in normal parameters. According to the six representations you can highlight the following aspects:

- Registration of foot is sufficiently balanced;
- Recording of left hand has more pronounced deviations than right hand, it means that the activity at the ventricle right is more accentuated than the ventricle left;

- The most accentuated derivatives of the three bipolar, is to the lead 1.

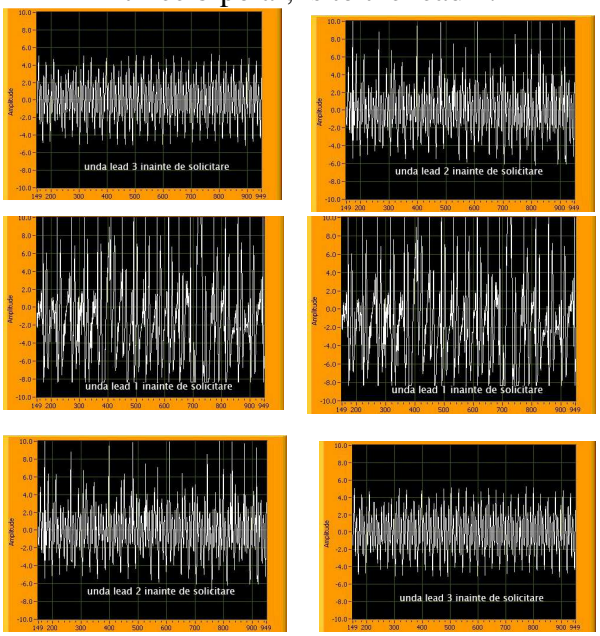

Fig. 6. ECG measurement before requesting to vibration for subject2

The representations from Figure 6 regarding the second human subject under investigation, it has a slightly modified approach towards normal electrocardiogram for a female subject. According to the six representations you can highlight the following aspects:

- Registration of foot is sufficiently balanced;
- Recording of left hand has more inferior deviations than right hand, it means that the activity at the ventricle left more accentuated than the ventricle right;
- The most accentuated derivatives of the three bipolar, is to the lead 1.

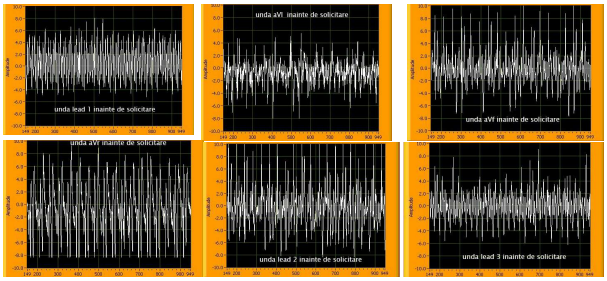

Fig. 7. ECG measurement before requesting to vibration for subject3

From reprezentations shown in Figure 7 concerning the third subject investigated, it appears that an electrocardiogram has faster approach towards normal for a male subject, even if it has a physics human condition above average at his age. According to the six representations you can highlight the following aspects:

- Registration of foot is sufficiently sharp;
- Recording of left hand has more inferior deviations than right hand, it means that the activity at the ventricle left more accentuated than the ventricle right;
- The most accentuated derivatives of the three bipolar, is to the lead 2.

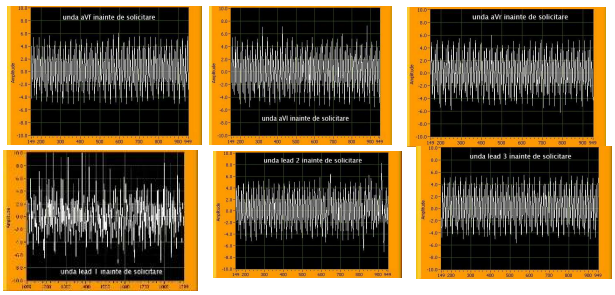

Fig. 8. ECG measurement before requesting to vibration for subject4

From representation shown in Figure 8 concerning the fourth investigated subject, it appears that an electrocardiogram has balanced, given the enough age of the female subject. According to the six representations you can highlight the following aspects:

- Registration of foot is sufficiently balanced;
- Recording of left hand has than right hand, it means that the activity at the ventricle left it is just as active than the ventricle right;
- The most accentuated derivatives of the three bipolar, is to the lead 1.

3.2. ECG Measurement during Request to Vibrations

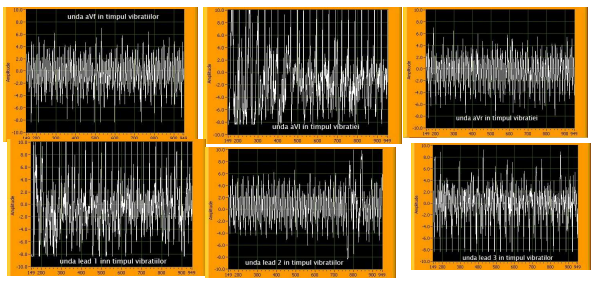

Fig. 9. Subject 1- Measurements during vibration application

Subjects were undergoing vibrating stimulus generated by a plate vibrator at a frequency of 30 Hz. ECG recordings are shown in the figures: 9, 10,11, and 12.

During subjected to vibration on a vibrating platform, the human body is undo to a continuous effort of balancing the body subjected to vibrations, which results in Figure 9, for the first human subject. It can show the following retail aspects:

- right leg is requested through vibrations, so oscillograms is more accentuated;
- heart activity is much improved, which results from Plots':
  - left hand (aVL);
  - bipolar deviations, given by lead 1 and lead 3.
- Note that the subject has a physics outstanding condition, and request him to vibration mode emphasizes the adaptation;
- Vibrations produce a change in the behaviour of the organism even in conditions of a subject who is trained.

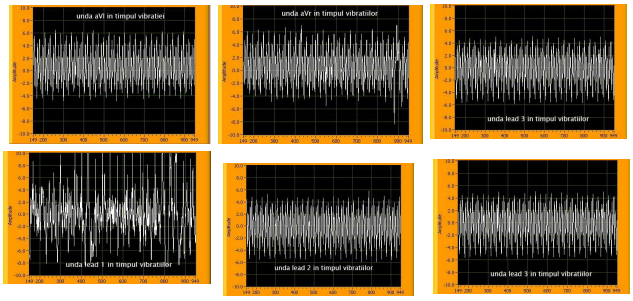

Fig. 10. Subject 2- Measurements during vibration application

During subjected to vibration on a vibrating platform, the human body is undo to a continuous effort of balancing the body subjected to vibrations, which results in Figure 10, for the second human subject. It can show the following retail aspects:

- right leg is less than requested by the vibrations, so oscillograms is more dominated;
- heart activity is equilibrated, which results from representations:
  - left hand (aVL);
  - right hand (aVR);
  - bipolar deviations, given by lead 2 and lead 3;
- These issues occur at this female subject, because the whole time in which they have been carried out the investigations, she was in motion, being continue involved in the activities, which could not be deferred.

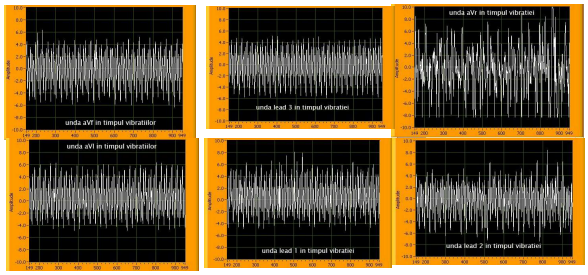

Fig. 11. Subject 3- Measurements during vibration application

During subjected to vibration on a vibrating platform, the human body is undo to a continuous effort of balancing the body subjected to vibrations, which results in Figure 11, for the third human subject. It can show the following retail aspects:

- right leg is requested through unnoticed vibration, because this human subject has been trained for some time vibrating plate, for the strengthening of the organism;
- the activity of the heart is little improved, due to long use of the vibrating platform;
- note that the subject has a good physics condition, and request them to vibrations mode emphasizes his adaptation;
- vibrations produce a change in the behaviour of the organism even in conditions of a subject who is trained.

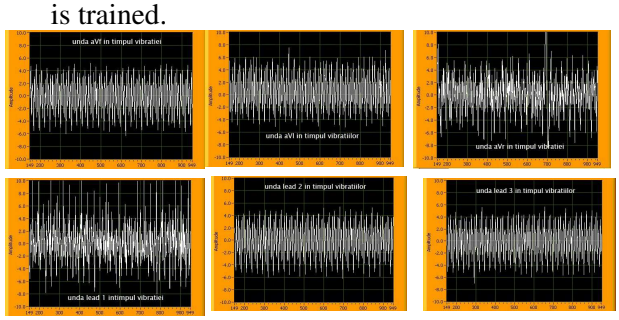

Fig. 12. Subject 4- Measurements during vibration application

During subjected to vibration on a vibrating platform, the human body is undo to a continuous effort of balancing the body subjected to vibrations, which results in Figure

12, for the fourth human subject. It can show the following retail aspects:

- right leg is less than requested by the vibrations, so oscillograms is more dominated;
- heart activity is equilibrated, which results from representations:
  - left hand (aVL);
  - bipolar deviations, given by lead 2 and lead 3;
- these issues occur at this female subject, because makes her activity mainly with right hand, and the representations for right hand are greatly increased and disorderly.

3.3. ECG MEASUREMENTS MADE AFTER EXPOSURE TO VIBRATIONS

Each human subject after exposure to vibration on vibrating platform was sitting on a chair and was let a short period of time at rest, in order to determine, which the remanence vibration action is over each subject separately. It will analyze both the bipolar activities due to biases of lead sites specified and unipolar led's due to biases for hands and right foot.

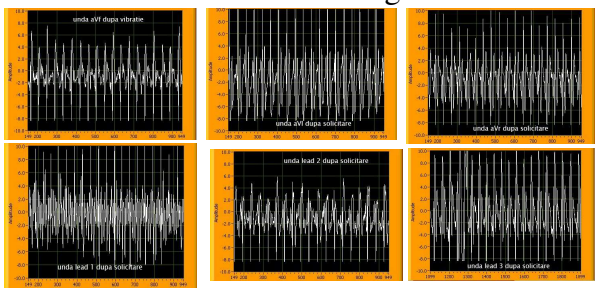

Fig. 13. Subject 1-Measurements after exposure to vibration

From representations of graphs in Figure 13, for human subject 1, after requesting the vibrations gradually recovers body setting up-it an easy slowdown in the heart rate (physiological bradycardia) as a reply to the body to vibrations. You can find the following:

- Amplitudes are more rarefied and it denoted that adapts at the request of the body through vibrations, they transform into energy;
- Return is done gradually, and therefore finds an agglomeration of the middle-wave.

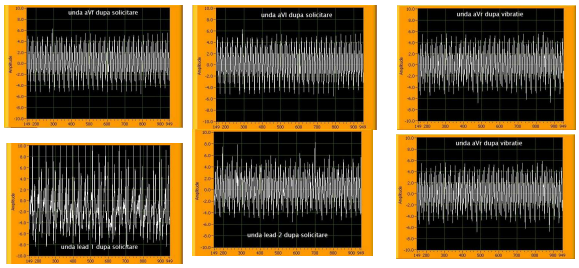

Fig. 14. Subject 2-Measurements after exposure to vibration

From representations of graphs in Figure 14, for human subject 2, after requesting to vibration body recovers quickly to normal, as a reply to the body to vibrations. You can find the following:

- Amplitudes are standardized and it denoted that the body of this human subject is adaptable to various solicitors of physics nature.

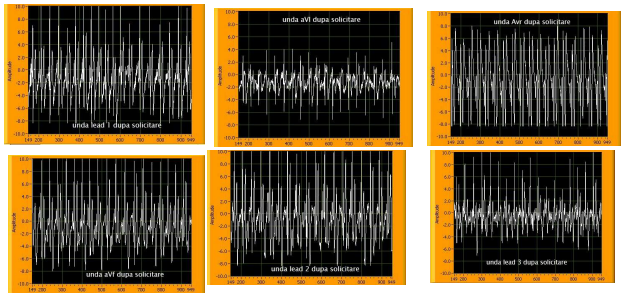

Fig. 15. Subject 3-Measurements after exposure to vibration

From representations of graphs in Figure 15, for human subject 3, after requesting the vibrations gradually recovers body setting up-it an easy slowdown in the heart rate (physiological bradycardia) as a reply to the body to vibrations. You can find the following:

- Amplitudes are more rarefied and it denoted that adapts at the request of the body through vibrations, they transform into energy;
- Return is done gradually, and therefore finds an agglomeration of the middle-wave.

From representations of graphs in Figure 16, for subject 4, after request from vibration body recovers more slowly due to the initial status of the age subject and of the incapacity of her body to return to the state prior to solicitation.

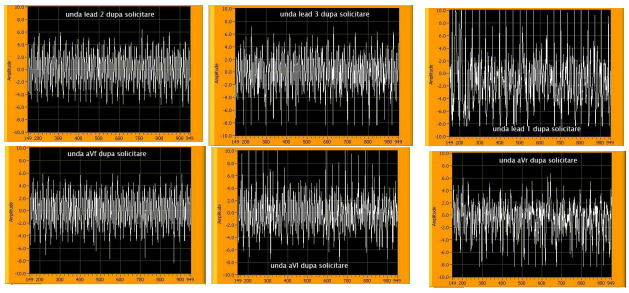

Fig. 16. Subject 4-Measurements after exposure to vibration

4. CONCLUSIONS CONCERNING THE EFFECT OF VIBRATION ON THE HUMAN BODY IN THERAPEUTIC POINT OF VIEW

A. Examination of the three distinct situations of ECG measurements on four human subjects subjected to vibrations on a vibrating platform can pull off in retail the following aspects:

1. The application to vibration has been carried out on a group of four persons, two female and two male.
2. Have chosen subjects of different ages, ranging between 37 and 68 years.
3. Subjects don't practice performance sport of different capacities.
4. Each human subject practices daily physical exercise.

B. in terms of therapeutic aspects that are highlights by applying solicitations to vibration, they can write that:

1. The female body is adapts easier to request through the vibrations than the male body, in terms of the experiment conducted on the four subjects.
2. Restoration of organism after request to vibration is faster at an average age subjects, approach towards those with higher age.
3. The subjects from physically trained more rapidly respond at the request of vibration, than those untrained.
4. It is recommended request by vibration with lesser amplitude and low frequency (30 Hz) for the person that non-practice performance sport of different capacities, because the body in a positive way by stimulating further result, which precedes a heart stress relieving walls and thus the body's arterial feeding is intensive and implicitly the prolongation of life.

C. There is a slight increase from this 30 Hz frequency sinusoid wave, enough for the body to perceive these vibrations in the form of physical exercise. Cardiac function was not altered significantly, but still there's a proven benefit over the wall's arterial stiffness, particularly in elderly people, therefore we can talk here of an easy reduction in blood pressure.

D. They can notice how there stil is the increased activity in cardiac muscle even after termination of the vibration stimulus. Constant in amplitudes remain for all four subjects which means that the request will take effect after the end of the vibrating stimulus.

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Studiu experimental al efectelor vibraţiilor asupra organismului uman din punct de vedere terapeutic

Rezumat: *In lucrare se face un studiu al acţiunii vibraţiilor asupra organismului uman, prin care se urmareste, sa se stabileasca efectul terapeutic al acestora. Studiul experimental pune in evidenta acţiunea vibratiilor prin punerea in evidenta a electrocardiogramei a patru subiecti, asupra carora investigatiile se efectueaza in trei etape. In prima etapa electrocardiograma se efectueaza inaintea aplicarii vibratii, a doua etapa este atunci cand asupra corpului actioneaza vibratiile produse de o plarforma vibratoare, iar in cea dea atreia etapa se inregsitreaza EKG dupa indepartarea sursei de vibratii. Rezultatele investigatiilor scot in evidenta posibilitatea efectului terapeutic.*

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