

# THE CHANGES IN BONE MARKERS ACTIVITY AFTER 19 DAYS OF VIBRATION TRAINING

by

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The main aim of this research was determination of influence of low frequency vibrations on phosphatases (acid and alkaline) and calcium concentration in serum of subjects with osteoporosis risk. Subjects were divided into two groups: 12 subjects from experimental group performed vibration platform exercises (15 min. per day) with 3.5 Hz frequency during 19 days of experiment. Before and after experiment venous blood was taken to determine the level of researched phosphatases activity and calcium concentration.

Statistical analysis showed that there was only small increase in activity of phosphatases and calcium concentration after training. In control group the calcium concentration and activity level of alkaline phosphatase was slightly decreased while acid phosphatase clearly higher

**Keywords:** low frequency vibrations, osteoporosis, phosphatases, calcium

## *Introduction*

During last decade many scientists search for new methods in physiotherapy including magnetic field or laser technology. Authors of many researches did not decided about negative changes, and found the increase in body immunity because of mastocytes degradation (Trelles and Mayayo 1992, see review). Unfortunately there is no analogical data describing the influence of above mentioned stimuli to calcium concentration in serum or phosphatases activity (acid and alkaline) treated as bone markers. Also the state of

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knowledge about the low frequency vibrations influence on human body, and especially on muscles and bones. As it is known, the general vibrations help to improve disordered energetic and regeneration processes in organism (Damian et al. 2002). Probably, it may be used in rehabilitation of broken bones, delayed healing of wounds and in some psychosomatic disorders. According to Engel (1993) the short-time action of lower frequency vibrations may activate the muscle functions, so it can imitate training.

The vibration may lead to body recovery through the energetic processes regulation and increase in human immunity. The properly adjusted vibrations frequency may imitate physical activity, especially in subjects who cannot, from healthy reasons, fulfill contemporary requirements. There is no any experimental data from research on humans about the influence of low frequency vibrations of phosphatases activity, assumed as bone markers. The only one work relates to Wistar rat experiment, where authors determined significantly increased calcium concentration in serum with simultaneous improvement in results of densometric examination (Damian et al. 2002). This research is one of the newest performed in humans.

### *Material and methods*

The experiment was conducted on 24 subjects aged from 39 to 55 years demonstrating low or at least medium physical activity from the healthy reasons, especially with osseous system. The experimental group (n=12) performed 19-days long training schedule on vibration platform (15 min. per day). The frequency was similar to slow human run frequency (3.5 Hz). All subjects needed rehabilitation treatment because of osteoporosis. All subjects were characterized with normal EKG record and were free from cardio-pulmonary problems. Before and after training the basic body parameters were registered including blood pressure and body temperature. Before and two days after experiment following biochemical markers were tested in venous blood:

- calcium concentration in serum (Biochemtest test),
- acid and alkaline phosphatases activity (enzymatic method from Biochemtest).

The acquired results were analyzed statistically including mean values, standard deviations and t-Student test for dependent variables.

### Results

Table 1. Mean values and standard deviations of analyzed variables in tested groups

Variable	Experimental (n=12)		Control (n=12)	
	Before	After	Before	After
Calcium concentration [mmol/l]	5,22±0,03	5,99±0,14	5,26±4,96	4,96±0,31
Alkaline phosphatase activity [UI]	15,75±6,01	15,95±10,28	30,82±7,98	28,23±10,14
Acid phosphatase activity [UI]	2,20±0,4	2,51±1,71	1,56±0,95	3,15±1,0

The mean values of calcium concentration (fig. 1, table 1) between two groups were almost similar and statistically did not differ. After 19 days of vibration training there was significant increase in experimental group, while insignificant decrease in control group. All above values fit into physiological norms.

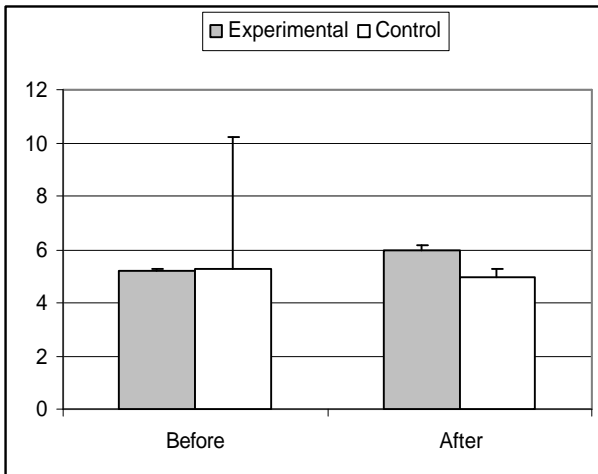


Fig. 1. The calcium concentration in serum in tested subjects

The activity of alkaline phosphatase slightly increased after vibration training but the difference was insignificant. In control group reversed trend was observable because activity slightly decreased. The results are presented in figure 2 and table 1. Regarding very wide range of physiological norm for this variable it can be stated that acquired results are valid.

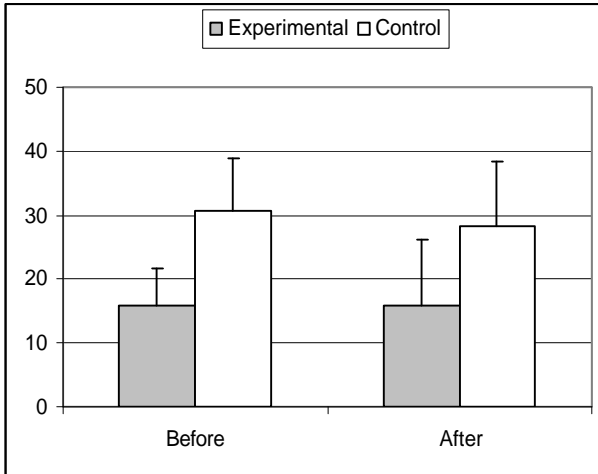


Fig. 2. The level of alkaline phosphatase activity in tested groups

As it can be seen on figure 3 the increasing tendency in mean values of acid phosphatase was observable. Only the scale of observed phenomenon is different. In control group the increase was more than twice higher, while in experimental only 0.22 UI

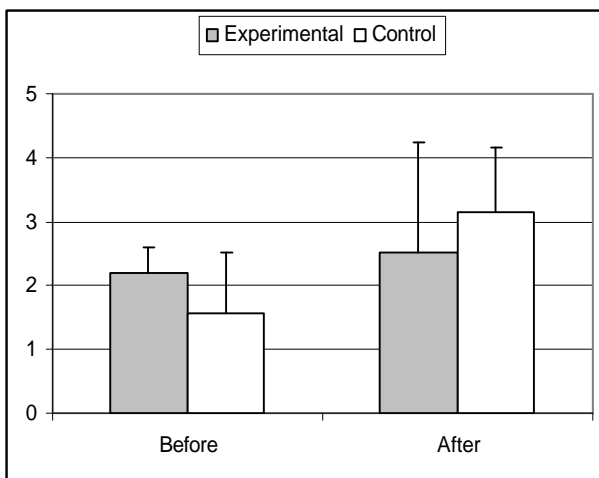


Fig. 3. The level of acid phosphatase activity in tested groups

### *Discussion*

The interpretation of changes in calcium concentration and phosphatases (acid and alkaline) activities under influence of low frequency vibrations is very difficult because of lack of other experimental data and literature. The above problem relates not only to low frequency vibration, which are only the attempts to find out new therapy methods, but also to used for many years methods in physiotherapy as magnetic field or laser techniques. It is difficult to explain, if the increase in calcium concentration in serum in experimental group was the result of bone deterioration or better absorption. Without hormonal determinations (coordinating calcium metabolism) it is impossible to explain clearly the acquired data. In order to receive more precise view on data the densitometry examination should be provided. According to Damian et al. (2001) it should be stated that authors observed similar occurrence, even in greater scale in Wistar rats and simultaneously better densitometry examination results. On other hand increase of calcium concentration is often accompanied with strengthening of osteoporosis, which was determined in subjects.

Observed increase in alkaline phosphatase activity, enzyme localized in osteoclasts may suggest increased metabolic activity of this cells, what could

be the negative occurrence. The reverse direction of changes was recorded in control group.

Acid phosphatase increased its activity in both groups, significantly in control group. This enzyme localized in osteoblasts, but its significant meaning in osteoporosis diagnostics seems to be doubtful. Because of different directions of changes in pilot studies on healthy subjects (unpublished data) and small number of subjects do not allow for any interpretations.

The acquired results may be treated as preliminary. They allow to state that low frequency vibrations influence the homeostasis of organism. Authors suggest further need of such type of research.

## REFERENCES

- Engel Z. 1993 *Ochrona srodowiska przed drganiami i halasem*. PWN Warszawa, 1993
- Damijan Z., Panuszka R., Majchrzak T., Ruminski M., Zychowska M., Dabrowski Z. 2002 *Changes of selectes Biochemical Parametrs of Rats Under Low Frequency Vibration*. Structures – Waves – Biomedical Engineering, Kraków 2002 pp. 149-159
- Damian Z., Panuszka R., Zychowska M. *Wplyw drgan o niskiej czestotliwosci na organizm czlowieka – dane niepublikowane (unpublished data)*.