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Nanotribology Impact of Run-Walk, Electro- Magnetic-Hydrodynamic Human Joint and Skin Lubrication on the Slimming and Metabolic Process

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Abstract

Purpose: The topic of the presented paper concerns the human body and joint cartilage run-walk treatment implemented by the electro-magnetic field. The thesis is proved here i.e., running in presence of an electro-magnetic field increases energy burn, metabolism and finally it leads to the decrements of the body weight and hence it accelerates the slimming process.

Materials and Methods: The research methods used in this paper include the following: electro-magnetic field produced by a new Polish Apparatus MF-24, MT-3, Germany Magcell Arthromagneto electronic devices for the human body and joint cartilage treatment, Segmental Body Composition Analyzer Tanita MC 780MA, pedometer Garmin Ltd (2015). The author gained experience in Germany research institutes, and practical results were obtained after measurements and information from students and patients.

Results: The electro-magneto-therapy results presented in this paper concern betterments during typical human cartilage diseases and causes of the effects of the slimming process gained before and after run-walk training. The run-walk training results presented in this paper concern the effects of the slimming process gained without and after electro-magnetic field therapy.

Conclusions: The main conclusions obtained in this paper are as follows: The run-walk training implemented by the electro-magnetic induction field leads to the increments of the dynamic viscosity of synovial fluid, changes the internal energy contained in the human body, muscle and cartilage, hence it accelerates the slimming process connected with the body weight decrements as well the betterments effects during the therapy.

Keywords: Run walk training; Variable electro-magnetic field therapy; Magcell arthromagneto electronic devices; Slimming process; Betterments of electro-magneto-therapy effects

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Introduction

After many contemporary achievements in the domain of the human slimming process, it is a well-known fact, that the magnetic induction field leads to the betterments of numerous human diseases and run-walk training accelerates the human body slimming process [1-5]. Despite of the above mentioned results, according to what the author knows, the mutual interactions of the run-walk training and magnetic induction field treatments on the therapy betterments of human diseases and on the human body weight decrements have not been examined so far [6-11].

The topic of the present paper concerns the positive effects obtained after gymnastic training, especially run-walk treatment implemented by the magnetic induction field. Hence, it was proved the corollary that the human body motion in presence of a magnetic field increases burn, metabolism and finally it leads to the decrements of the body weight, and hence it accelerates the slimming process.

During the electro-magneto-therapy treatment a variable-pulsed magnetic induction field is produced in the surrounding of the joint gap and its cartilage surfaces. It is worth to notice that a successful electro-magnetic treatment for concrete disease, ought to indicate and require the exact values of therapy parameters, namely: an interval of magnetic induction values for example in mT, the treatment duration, the shape of the magnetic induction field lines. The above mentioned data will be considered in this paper.

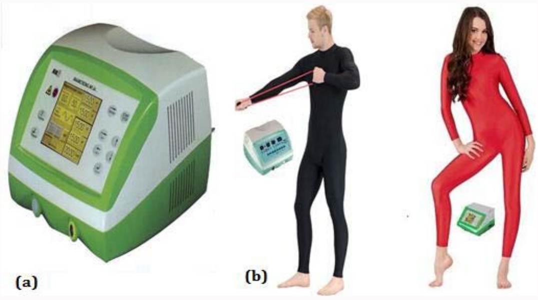

Figure 1: Application of the Polish electronic device: a) a new multi-channel Apparatus MF-24 with a new control system [20], b) gymnastic implemented by the electro-magnetic field from Apparatus MF-8 and MF-24.

Figure 2: Application of Applicator: a) AS-200N, AS-315N, AS-600N [21], b) gymnastic implemented by Applicators.

Figure 3: Application of German electronic device: a) Magcell Arthro Therapy Device, b) gymnastic implemented by Magcell Arthro, c) two sports-women treated by the electro-magnetic field.

If such parameters are not preserved, the magnetic therapy performed can finish with adverse effects namely with a regression of illness symptoms or without betterments or with deterioration [12]. For the human body motion in the presence magnetic induction therapy we can establish and explain the processes of prevention of the loss of the dynamic viscosity of synovial fluid and to explain the role of friction forces changes in the lubrication of cartilage surfaces during the disease duration [13-15].

Materials

Various materials are presented here including magneto electronic devices, to recognize the betterments during human diseases simultaneously with the human body weight decrements.

The material presented in this section is exactly divided adequately to the final results obtained in following two parts, namely: A new magneto-electronic devices as lifeless materials and, living materials.

Electronic devices (lifeless materials)

At first, in this section, new magneto-electronic devices are presented and described.

Some particular treatment-measurement results obtained in this paper using a new Polish MT-24 electronic device are compared with corresponding results gained using Germany PEMF-Magcell-Arthro electronic devices [16-19]. In both devices mentioned a magnetic induction field was delivered from an external side.

- A new Polish Apparatus MF-24 presented in Figure 1a, produces a magnetic induction field from 0 mT to 20 mT, with frequencies from 1 Hz to 100 Hz and amplitude from 0.5 s to 8 s. The weight of Apparatus MF-24 is 600 N, and its size: 142 mm × 364 mm × 335 mm [20]. The power supply has the values of 230 V/50 Hz/300 W.
- Applicators with various magnitudes (for diameters 200, 315, 600 mm) are illustrated in Figure 2a. Such applicators deliver a magnetic induction field with sinusoidal, rectangular and triangle shapes to the pathological cartilage on the joint surface and, simultaneously, the proper gymnastic training is recommended [19,21].
- Another apparatus is PEMF-MAGCELL-ARTHRO presented in Figure 3 with recently applied treatment in knee osteoarthritis after proper gymnastic training [2,4,16,18,22,23].

The Magcell Arthro Apparatus is hand held and battery-driven; no coils are used for field generation. The disc area of 28 cm^2 is magnetically active and available for treatments. Disc rotation is varied in 2 Hz steps to produce frequencies between 4 Hz and 12 Hz. The Magcell device produces time varying magnetic induction field of about 105 mT flux density [1,4,16]. The pedometer Garmin Ltd. (2015) electronic device with the vivofit band is presented in the Figure 4. Such settings are paired and downloaded using a computer with Windows and complete the setup.

Two kinds of Japan Segmental Body Compositor Analyzer (SBCA) TANITA BC-418 MA and SC 240 are illustrated in Figure 5.

SBCA, BC-418 MA presented in Figure 5a consists of 5 body segments, namely: the trunk, the left arm, the right arm, the left leg, and the right leg. An accurate segmental body composition profile is printed within seconds. It is possible to perform an 8-polar bio-electrical impedance analysis (BIA). A handy printout shows results for BMI, BMR, Fat%, Fat Mass, Fat Free Mass, Total Body Water, and desirable ranges for Fat% and Fat mass.

Figure 4: Electronic pedometer Garmin LTD 2015:1,2-water proof pedometer vivofit band and pedometer montage; 3-pedometer with montaged band.

a b

Figure 5: Segmental Body Composition Analyzer: a) SBCA,BC-418 MA, b) SBCA,SC-240.

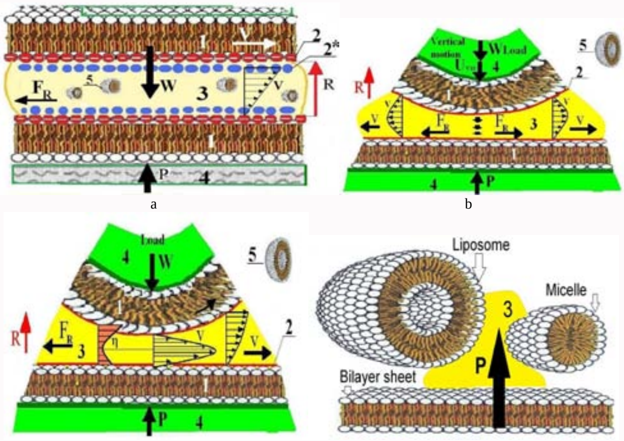

Figure 6: The joint gap limited by the various shapes of the phospholipid (PL) bilayer, a) the elliptic or spherical shapes of the PL bilayer in lubrication by rotation, b) the parabolic shapes of the PL bilayer in lubrication by squeezing, c) right-linear shapes of PL bilayer in lubrication by rotation, d) SF between PL bilayer sheet and Liposome & Micelle. Notations: 1-the PL-bilayer (2 nm height), 2-hydrated $-PO_4^-$ group, and hydrated sodium ions, 3-synovial fluid, 4-collagen and cartilage region, 5-Liposom occurring in synovial fluid, W-Load, P-hydrodynamic pressure force, R-Repulsion force, V-velocity of the upper surface, F_R-Friction force, η-viscosity distribution of synovial fluid.

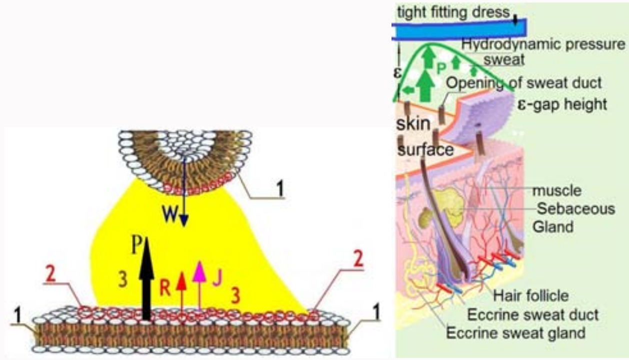

Figure 7: The effects of hydrodynamic pressure: a) Pulsed electro-magnetic fields (PEMF) from external device into the phospholipid membrane lying on the cartilage superficial layer for squeezing lubrication, b) Sweat lubrication between skin and tight fitting dress surface:1-PL bi-layer, 2-lipids with negative charge, 3-SF-synovial fluid, R-repulsion force, J-current density supplied from PEMF-MAGCELL device.

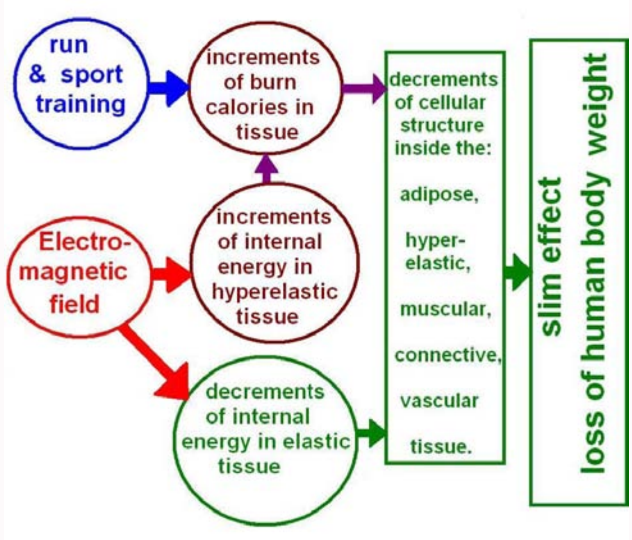

Figure 8: A view of the sliming process of human body tissue.

SBCA, SC-240 presented in Figure 5b has a clear body composition monitor. The device is light (about 4.53 kg) and highly portable with a built-in handle. It has a large platform (43.7 cm × 34.2 cm) to measure weight. It has an ability to provide a more detailed analysis when connected to an external device, such as a PC. The aforementioned analyzer measures the human body weight in kg, the BMI index in kg/m^2, the external human body fat in percent, water in the human body in percentage, the internal human body fat in a scale from 1 to 59, human muscle in kg & %, the human bone mass in kg, and the human Base Metabolic Rate (BMR) in Kcal/day. Hence we can calculate the human metabolic age.

Living materials

Now we show magnetic induction treatment by means of an internal and external administration of a magnetic field into and onto the sound and pathological human skin or cartilage surfaces occurring in the human hip joint. Such bodies include the following living materials: the normal human joint, the cartilage with the phospholipids bi-layer or the sportsman's skin. The PL-bi-layer lining the negatively charged hydrophilic cartilage surfaces in various human natural joints are presented in the Figure 6 [15,22].

PL-bi-layers lining the negatively charged hydrophilic cartilage surfaces with hydrodynamic pressure P in the human natural hip joint presented in Figure 7a can be supplied by external PEMF [6]. The gap filled with the sweat between the sportsman's external skin surface and internal surface of the tightly fitting dress with hydrodynamic pressure effects is presented in Figure 7b.

The joint gaps in Figure 7a are limited by the upper and lower phospholipid membrane (PL-bi-layer) and are filled with synovial fluid. We have the load carrying capacity force denoted by the letter P and caused by the hydrodynamic pressure obtained from squeezing during the lubrication process. The repulsive force R is visible here that is caused by the negatively charged phospholipids membrane especially of the $(-PO_4^-)$ groups with sodium counter-cations strongly hydrated in the presence of synovial fluid. Such charged surfaces are observed on the both external PL-bi-layer surfaces contacting synovial fluid. Magnetic particles are combined with hydrogen ions H^+ in SF which enables the necessary and desired SF viscosity increments [8]. In general the senses and lines of forces R and P are the same.

The repulsion force R caused only by the electrostatic charged cartilage surface is negligibly small but a mutually conversion of the aforementioned charge with power hydrogen ion concentration pH in SF leads to about 5 percentage decrements of the synovial fluid (SF) dynamic viscosity. Supplied Pulsed Electro-Magnetic Field (PEMF) from an external side by the MAGCELL device to the PL-membrane has the quantity of current density J of about 43 mA/m² [18] and it generates repulsion forces as it gives important SF viscosity increments suitable for osteoarthritis treatments [1,4,16,18,22]. The load force W of the presented human joint, has in general the reverse sense.

The Figure 7b shows the phenomenon of hydrodynamic pressure after sweat lubrication in the thin gap between the movable external skin surface and leggings or a tightly fitting dress surface.

Methods

Here are presented the various methods, to accelerate the betterments during human diseases simultaneously with the human body weight decrements.

The methods presented in this section have been now exactly divided adequately to the final results obtained in the following parts namely: theoretical methods, experimental methods, and anamnesis methods.

Analytical methods

Now we are going to show the analytical methods to present the advantages of the run, walk and magnetic therapy. Analytical considerations are valid for three mutually connected problems namely: lubrication methods of the human joint in the presence of PEMF, the skin of human body lubricated by the sweat and loss weight methods of the human body. Lubrication problem of the human hip joint is presented by means of the conservation of momentum, continuity, energy and Maxwell's equations as well for synovial fluid, as a sweat liquid lubrication flow [17,24-26].

We assume a rotational, periodic and unsteady, isothermal, incompressible flow of viscoelastic synovial fluid and sweat in an electro-magnetic field, a periodic time-dependent gap height. In numerical ways the influences are proved of the magnetic induction field on the synovial fluid and sweat viscosity increments and next human joints load carrying capacity increments after a magnetic induction therapy.

The above mentioned equations for synovial fluid and sweat are in the following forms, namely, the equation of motion:

$$Div\mathbf{S}+\mu_0(\mathrm{N}\nabla)\mathrm{H}+\mathrm{J}\times\mathrm{B}=\rho\frac{dv}{dt} \tag{1}$$

the continuity equation:

$$\mathrm{div}(\mathbf{v})=0, \tag{2}$$

the reduced Maxwell equation:

$$\nabla^2\mathbf{H}=\mu_m\mu_e\frac{\partial^2\mathrm{H}}{\partial v^2\mathrm{t}} \tag{3}$$

the conservation of energy equation:

$$div(\kappa grad\ T)+div(\mathbf{vS})-\mathbf{v}\mathrm{Div}\mathbf{S}-\mu_m\mathrm{T}\Xi(\mathbf{v}\nabla)\mathbf{H}=0, \tag{4}$$

where: S - the stress tensor (Pa), v - synovial fluid velocity (m/s), H - the magnetic intensity vector (A/m) with the components (H_1, H_2, H_3), N - the magnetization vector (A/m) with components (N_1, N_2, N_3), μ_m - the magnetic permeability coefficient of synovial fluid ($mkgs^{-2}A^{-2}$), μ_e - the electric permeability coefficient of synovial fluid ($s^4A^2m^{-3}kg^{-1}$), κ - thermal conductivity coefficient of the fluid (W/mK), Ξ - first derivative of the magnetization vector with respect to the temperature (A/mK), T - temperature (K).

We assume that synovial fluid is a good insulator, i.e., its electric conductivity coefficient σ=0. Moreover, for synovial fluid and sweat liquid, the second-order approximation of the general constitutive equation given by Rivlin and Ericksen, can be written in the following form [5-11]:

$$\mathrm{S}=\rho I+\eta_0\mathrm{A}_1+\alpha(\mathrm{A}_1)^2+\beta\mathrm{A}_2,\mathrm{A}_1\equiv\mathrm{L}+\mathrm{L}^T,\mathrm{A}_2\equiv grad\mathrm{a}+(grad\mathrm{a})^T+2\mathrm{L}^T\mathrm{L},a=\mathrm{L}v+\frac{\partial v}{\partial t} \tag{5}$$

where: p - pressure, I - the unit tensor, A_1, and A_2 - the first two Rivlin-Ericksen tensors, L - the tensor of gradient fluid velocity vector (s^{-1}), L^T - the tensor of transpose of a matrix of gradient vector of a biological fluid (s^{-1}), t - time (s), a - the acceleration vector (m/s^2). The symbols: η_o, α, β stand for three material constants of synovial fluid, where η_o denotes dynamic viscosity (Pas), the symbols α and β determine the pseudo-viscosity coefficient (Pas^2) and describe the friction forces between viscoelastic particles of synovial fluid. The acceleration terms have been neglected. Only time derivatives of velocity component have been retained. The tangential and vertical acceleration of joint surface, variable with time, is taken into account. We also neglect the terms of the order Reynolds number × Ψ and $\Psi \equiv \varepsilon/R \equiv 10^{-3}$ where R is the radius of curvature of bone surface, ε-characteristic gap height value, and we neglect the centrifugal forces. We assume that the components of the magnetic intensity vector and the components of the magnetization vector are constant in the height direction of the joint gap. We apply the curvilinear, orthogonal system of co-ordinates α_1, α_2, α_3 with the respective Lamé coefficients h_1, h_2, h_3. From the boundary conditions of the thin layer it follows that h_2=1.

The loss weight method of human body is referring to indicate the way of the human sliming process caused by the electro-magnetic field. In general such process is described by the equilibrium of momentum and the heat transfer equation for the cellular structure of cartilage tissue in the human joint and skin tissue on the human body. The aforementioned equation has the following form: [24,26]:

$$Div\mathbf{S}^*(T)+\rho_e^*\mathbf{E}^*+\mathbf{J}\times\mathbf{B}=0,\quad \mathbf{S}^*\equiv\mathbf{S_c}+\mathbf{S_{cg}}+\mathbf{S_g},\ div\left(\kappa^* gradT^*\right)=0 \tag{6}$$

The symbols with an asterisk are related to the tissue body and its structure body. We denote: S_c - classical stress tensor, S_{cg} - congenial growth tensor of cartilage, S_g - stress influences on the tissue growth. Soft tissue may be regarded as a composite non-isotropic, non -homogeneous, more or less incompressible finitely deforming damaging, linear or non-linear viscoelastic, hypo-elastic, hyper-elastic, anisotropic and non-linear elastic tissues. The hypo-elastic cellular structure of various tissues has the following properties: 1) The tissue deforms reversibly i.e., removing the load gives returning to the initial shape, 2) The stress depends only on strain and stress can be a non-linear function on strain and it does not depend on the rate of loading, 3) Isotropic tissue features, i.e., the response of a tissue is independent of its orientation with respect to the loading direction [4,8].

Table 1: The data read from the SBCA BC-418-MA before training for student-girls U, V, and W.

Name of Segmental Body Composition (SBC) parameter	Girl U before training	Girl V before training	Girl W before training
Weight (kg)	69	74	75
BMI (kg/m^2)	27.99	28.54	28.57
External body fat in %	29	30	31
Water in %	45	46	47
Internal body fat (-)	14	16	17
Muscle mass kg	55	60	61
Bone mass kg	2.1	2.2	2.3
Chest(bust) circumference cm	121	123	125
Abdomen circumference cm	71	75	77
Circumference of the hips	115	120	121
BMR,Kcal	1700	1750	1650
Metabolic age (in year)	22	23	24

Table 2: The SBC data read from the BC-418-MA after 10 days training for girls U (loose dress), V (tightly fitting dress), W (tightly fitting dress and magnetic field).

Name of Segmental Body Composition (SBC) parameter	Girl U after training	Girl V after training	Girl W after training
Weight(kg)	66.5	69.1	69.7
BMI (kg/m^2)	26.97	26.65	26.55
External body fat in %	27.0	26.0	25.0
Water in %	46	48	49
Internal body fat (-)	13	14	14
Muscle mass kg	56	61	62
Bone mass kg	1.9	2.0	2.1
Chest (bust)circumference cm	121	124	126
Circumference of the abdomen cm	70	73	74
Circumference of the hips	116	121	123
BMR,Kcal	1750	1840	1850
Metabolic age (in year)	21	21	21

Table 3: The percentage SBC data after 10 days training in comparison with the data before training (Table 2) for girl U (loose dress), V (tightly fitting dress), W (tightly fitting dress + magnetic field from PEMF device.

Name of Segmental Body Composition (SBC) parameter	Girl U after training	Girl V after training	Girl W after training
Weight	96.38%	93.30%	92.9%
BMI (kg/m^2)	96.38%	93.30%	92.9%
External body fat in %	93%	87%	80%
Water in %	102%	104%	104%
Internal body fat (-)	92.8%	87.5%	82.3%
Muscle mass kg;%	102%	102%	102%
Bone mass kg	100%	100%	100%
Chest(bust) circumference cm	100%	101%	101%
Circumference of the abdomen cm	98.6%	97.3%	96.1%
Circumference of the hips	100.8%	100.8%	101.6%
BMR,Kcal	102.9%	105.1%	112.1%
Metabolic age (in year)	95.4%	91.3%	83%

The hypo-elastic models of cellular structure feature are distinct from hyper-elastic tissue models (or standard elasticity models) in that, except under special circumstances, they cannot be derived from a strain energy density function per unit tissue volume U(Pa). We denote following symbols: E(V/m)-electric intensity, B(T)-magnetic induction field, ρ_e(C/m^3=As/m^3) - electric space charge in the tissue.

It is known that running or any other sport training leads to the increments of the calories burnt inside tissue of human body. Such increments lead to the decrements of the cellular structure of the adipose, elastic, muscular, connective tissues. And hence follows the slim effect connected with the loss of the human body weight.

During the electro-magnetic therapy, we have two possibilities of the e-m field activity. The first possibility refers to the case when thee-m field leads to the increments of internal density energy U(Pa) inside the hyper-elastic tissue. Such increments are going to the increments of the calories burnt in tissue. This case tends finally to the slim effect according to the effect of the processes described above. The second possibility refers to the case when the e-m field leads to the decrements of internal density energy U(Pa) inside the elastic tissue. Such decrements lead directly to the decrements of the cellular structure of the adipose, elastic, muscular, connective tissues. And hence follows the slim effect connected with the loss of the human body weight. Such a process is presented in Figure 8.

As well as bio-fluids (synovial liquids, human sweat), solid living materials (joint cartilage, PL-bi-layer, human body skin) have various viscoelastic, hyper-elastic, hypo-elastic features.

The calculations presenting the lubrication in the presence of PEMF and the slimming process, requires an implementation of the abovementioned system of Equations 1-6 by the proper constitutive dependencies between the stress and strain tensor and non-linear geometrical relations between shear rate and velocity components for the fluid or between strain components and displacement vector components for the bio-materials (skin, cartilage).

Experimental methods

Three young girls are taken into account with following data:

- U-18 years old, height 1.57 m, weight 69 kg, i.e., BMI=27.99;
- V-19 years old, height 1.61 m, weight 74 kg, i.e., BMI=28.54;
- W-20 years old, height 1.62 m, weight 75 kg, i.e., BMI=28.57;

Segmental Body Composition Analyzer (SBCA) TANITA BC418 MA applied for student-girls U, V, and W gave the data presented in Table 1. The Tanita SBCA provide the most accurate and detailed data in bioelectric impedance testing (author's own research).

Experimental method is based on the sport training effects obtained for selected U, V, and W healthy girls 18, 19, and 20 years old, similar heights and with the similar SBC (Segmental Body Composition) data presented in Table 1. The amount of daily steps, distances in kilometers, total calories, burnt calories burnt was read from the Garmin 2015 pedometer and SBC data was obtained from the Analyzer BC-418MA.

Anamnesis methods

This method is realized from two sources. In the first source we obtain data from the author's own and literature measurements. In the second source, we obtain data after an individual inquired anamnesis from 20 patients in Tech High School Mittelhessen Giessen in Germany.

Results

Experimental results obtained after walk, run training

The run and walk of each girl U, V, and W was performed twice daily for 60 min a total of 25,000 steps over a distance of 18 km in a period 10 days in the form of run and walk. Girl U was trained run and walk in a classical loose dress. Girl V used a tightly fitting dress. Girl W was trained run and walk in a tightly fitting dress with the PEMF Magcell Arthro Device in the dress pocket. The electro-magnetic field applied attained frequencies of about 15 Hz and a magnetic induction of about 70 mT. The training effects in the form of SBC data from the analyzer BC-418-MA for student-girls U, V, and W are presented in Table 2.

Percentage SBC data obtained after training (Table 2) in comparison (in relation) with the corresponding data before training (Table 1) a represented in Table 3 for girls U, V, and W.

Necessary treatment parameters for various diseases therapy aided with run or walk

In this section, the hypothesis is examined that the electro-magnetic therapy of selected diseases is more efficacious if and only if it is connected with the proper sport training for example in the form of systematically and not intensive run-walk. Therefore, an attempt is made to present the necessary parameters of the treatments for selected diseases with simultaneously steps number required once a day during the run or walk therapy.

At first, we show the necessary treatment parameters and the necessary steps number required during the efficacious therapy of selected diseases using both MF-24 and PEMF Magcell Arthro electronic device. For five selected diseases therapy, Table 4 shows exactly indicated the following necessary treatment parameters namely magnetic induction field, frequencies, the shape of field lines, the treatment duration of the therapy and the walk steps number.

The geometrical shapes of magnetic induction field lines and its changes in the therapy duration as well as proper induction magnetic values have an important influence on the final success of the treatment performed.

In accordance with the author's experience gained in German research institutes of Biological Boundary Layers in Karlsruhe, and Jaw Orthopedics Clinic in Göttingen, and in the Giessen University Giessen, the thermal deformation of a joint under a magnetic induction field may change the joint's gap height by about 15% which, in consequence, has an influence on the pressure and capacity changes by about 30%. The realized research on magnetic and thermodynamic properties of biomaterials will change the traditional methods of calculation of the deformation values of the human joint gap height. Most often, the deformations have not been determined so far [22,26].

In general the magnetic induction field is perceptible and noticed if its value is greater than the Earth magnetic induction field i.e., about 30 μT to 70 μT ($T=kg/s^2$;$A=Wb/m^2$).

Results obtained from experiment and anamnesis

Now we proceed to the data obtained after individual anamnesis on the grounds of the data values manifested in Table 5 and constituted during the experimental measurements. Table 5 shows the efficacy, of the symptoms of magnetic treatments and betterments presented in percentage values obtained on the grounds of anamnesis deduced after treatments presented in Table 4 column 1 and 2 for the same five typical diseases and its localization in human body numbered by 1, 2, 3, 4, and 5.

Experimental methods are made using the Polish electronic device MF-24 and the Germany PEMF Magcell Arthro magneto electronic devices during the walk, run and in the case of the therapy of human joint cartilage diseases. The therapy performed by PEMF Magcell Arthro lasted for a period of 18-20 days. Treatment took place twice daily for 5 min for all. Upon pressing the start button in PEMF Magcell Arthro Apparatus (Figure 3) the device ran and stopped automatically after 2 min and 30 sec. We make this operation two times consecutively. After the first treatment, the area was changed

Table 4: Typical proper values of magnetic induction field, frequencies and shapes of field lines applied during the treatments in concrete disease and illness localization after author studies and anamnesis using Apparatus MF-24 with a new control system and PEMF MAGCELL-ARTHRO apparatus for five typical diseases numbered by 1, 2, 3, 4, 5 indicated in column 1 for various localization given in column 2.

Disease/ with required walk, run steps number	Localization	Magnetic induction	Frequencies	Shape of field lines	Treatments duration Using 24-MT or (PE MF MAGCELL AR-THRO Apparatus)
Degeneration changes, inflammation of vertebral joints, disc diseases/every day 10,000 steps	Lumbar vertebral column	10-20 mT	10-20 Hz	Triangle or rectangular	Once a day, 15 min (twice daily for 5 minutes, together 10 minutes) per 18 days,
Limb joint diseases/every day 8,000 steps	Hip joint	20 mT	20 Hz	Triangle	Once a day, 12 min (twice daily for 5 minutes, together 10 minutes) per 21 days
Limb joint diseases/every day 12,000 steps	Shoulder joint	15 mT	20 Hz	Rectangular	Once a day, 12 min (twice daily for 5 minutes, a total of 10 minutes) per 21 days
Limb joint diseases/ every day 12,000 steps	Knee, Elbow, Phalange joint	15 mT	20 Hz	Rectangular	Once a day, 12 min (twice daily for 5 minutes, together 10 minutes) per 21 days
Osteoporosis, Osteoarthritis/every day 8,000 steps	Hip, Knee, Elbow,	10-20 mT	10-20 Hz	Rectangular and Triangle	Three time a day for 10 minutes, together 30 min. (twice daily for 10 min. a total of 20 min.) per 21 days

Note: Data in parenthesis are referring to the treatments duration performed by Magcel Arthro Apparatus.

Table 5: Anamnesis results of the evaluation of efficacy deduced after magnetic therapy presented using Apparatus MT-24 with a new control system (and PEMF MAGCELL-ARTHRO apparatus) for selected diseases and its localization in the human body numbered by 1, 2, 3, 4, 5 accordingly to subjective patients feeling.

Name of disease and number of tested patients	Regression of symptoms	Significant betterment	Betterment	Without betterment
Degeneration changes, inflammation of vertebral joints, disc diseases	15% (20%)	45% (40%)	35% (30%)	5% (10%)
Limb joint diseases, hip joint	50% (45%)	25% (30%)	20%	5%
Limb joint diseases, Shoulder joint	0%	49% (55%)	31% (30%)	20% (15%)
Limb joint diseases, Knee, Elbow, Phalange joint	10% (5%)	45% (40%)	35% (45%)	10%
Osteoporosis, Osteoarthritis, for Hip, Knee, Elbow	10% (5%)	40% (45%)	45% (40%)	5% (10%)

Note: Data in parenthesis refer to the treatments performed by PEMF Magcel Arthro Apparatus and implemented by the indicated run-walk).

and the device started for a second time. Treatment areas included the anterior surface i.e., cartilage at the top of the lateral femur, and the interior surface of the joint directly below the femur cartilage.

Conclusions

After many experiences and information from patients, sportsmen and after initial analytical considerations and experimental measurements, we can present the following conclusions about the efficacy of the performed magnetic induction and electro-magnetic therapy.

The magnetic induction field increases the dynamic viscosity of synovial fluid during the cure, treatment, and during the run, walks training. Synovial fluid viscosity increments imply an enlargement of the human joint hydrodynamic pressure values, increases the joint load carrying capacity values and increases in the efficiency of human limbs.

The significant effects on the SF viscosity variations caused by electrostatic charge generated on the joint PL membrane and enlarged with the external PMEF are visible if two effects particularly in the presence of boosted squeezing and weeping joint lubrication are considered simultaneously, and if we have mutually influences of the power hydrogen ion concentrations after a dissociation process in the joint gap and proper electric charge on the superficial cartilage layer.

The Pulsed Electro-Magnetic Field (PEMF) applied during the run and sport training increases the sliming process of the human body and it manifested with the body human loss weight, i.e., decreases in the Body Mass Index (BMI in kg/m^2) in comparison with the body human weight and BMI in kg/m^2 values occurring after run or walk without Pulsed Electro-Magnetic Field (PEMF) effects.

The Pulsed Electro-Magnetic Field (PEMF) applied during the run and sport training:

- Decreases the Human Metabolic Age (HMA)
- Increases the Basal Metabolic Rate (BMR in Kcal) index

In comparison with the human metabolic age and with BMR values in Kcal occurring after run or walk without Pulsed Electro-Magnetic Fields (PEMF) effects.

The Pulsed Electro-Magnetic Field (PEMF) applied during the run and sport training increases the water contents and decreases both external and internal fat in the human body, in comparison with the water contents as well as both external and internal fat in the human body, which occurs after run or walk without Pulsed Electro-Magnetic Fields (PEMF) effects.

The classical magneto-therapy for the hip, knee, shoulder, elbow and human joint implemented by the PEMF effects and properly indicated run or walk, increases the betterments of performed treatments in comparison with the betterments occurring after the classical magneto-therapy treatments without (PEMF) effects and without run or walk training.

The SBC values obtained after training for girl-student U, V, and W indicate that the decrements of the body mass index BMI, external and internal body fat, metabolic age are larger in the case when the tightly fitting dress was used (column V & W) in comparison with the abovementioned decrements for the loose dress (column U).

The SBC values obtained after training for girl-students U, V, and W indicate that the increments of the water, muscle mass, BMR index are larger in the case when the tightly fitting dress was used (column V & W) in comparison with the abovementioned increments for the loose dress (column U).

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