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Research Article

The Metabolic Process After Lubrication of Human Joint and Skin Surfaces

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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 (EM) and Acoustic Emission (AE) field. The thesis is proved here i.e. running in presence of an EM and AE field, increases dynamic viscosity of bio-lubricant liquids, thus increases energy burn, metabolism and finally it leads to the decrements of the body weight and hence it accelerates the slimming process.

Material and Methods: The research methods used in this paper include the following: EM field produced by a new Polish Apparatus MF-24, MT-3, Germany Magcell Arthro magneto electronic devices for the human body and joint cartilage treatment, Bone Dias Apparatus applied in AE therapy produced in Germany, (Univ. Applied Science Giessen), 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 EM-therapy and AE 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 and AE leads to the increments of the dynamic viscosity of synovial fluid and human sweat, 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.

Key words: Run walk training; variable EM field –therapy; magneto electronic devices; Bone Dias; AE therapy and diagnosis; slimming process and betterments after therapy effects

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[3,5,7,9,16,21,23].Despite of the abovementioned results, according to what the author knows, the mutual interactions of the run-walk training and magnetic induction and AE field treatments on the therapy betterments of human diseases and on the human body weight decrements have not been examined so far [13,14,15,17,18,19,25].

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

During the EM-therapy and AE treatment a variable-pulsed magnetic induction and AE field is produced in the surrounding of the joint gap and its cartilage surfaces or between human skin and gymnastic dress. It is worth to notice that a successful EM or AE 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, an interval of AE sound intensity in decibel, the treatment duration, the shape of the magnetic induction and AE field lines. The abovementioned data will be considered in this paper.

If such parameters are not preserved, the EM and AE therapy performed can finish with adverse effects namely with a regression of illness symptoms or without betterments or with deterioration [6]. For the human body motion in the presence magnetic induction therapy and AE we can establish and explain the processes of prevention of the loss of the dynamic viscosity of synovial fluid or sweat and to explain the role of friction forces changes in the lubrication of cartilage or human skin surfaces during the disease duration [8,12,22].

Materials

Various materials are presented here including magneto electronic and AE 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:2.1 A new magneto-electronic or AE devices as lifeless materials and,2.2- 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 [11,20,21,24,26].In both devices mentioned a magnetic induction field was delivered from an external side.

• A new Polish Apparatus MF-24 presented in Fig. 1a produces a magnetic induction field from 0 to 20 mT, with frequencies from 1 to 100 Hz and an amplitude from 0.5 to 8s. The weight of Apparatus MF-24 is 600N, and its size [28]: 142×364×335mm. The power supply has the values of 230V/50Hz/300W.

•A new Germany BoneDias Apparatus elaborated by the Burkhard Ziegler [25] presented in Fig.1cd produces acoustic waves emission with respect to the orthopedic diagnostics and ill cartilage or human skin treatments.

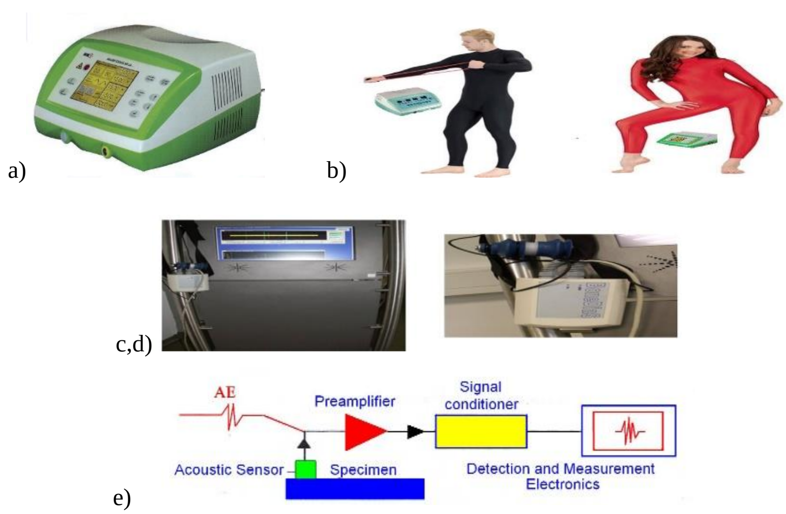

Figure 1: *Application of the electronic devices: a) a new Polish multi-channel Apparatus MF-24 with a new control system [27],b)gymnastic implemented by the electro-magnetic field from ApparatusMF-8 and MF-24, c) Bone Dias general view, d) sensor, Bone Dias filter and amplifier AE[25],e)Scheme of an AE measurement system*

• Applicators with various magnitudes (for diameters 200, 315, 600mm) are illustrated in Fig. 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 [26],[27].

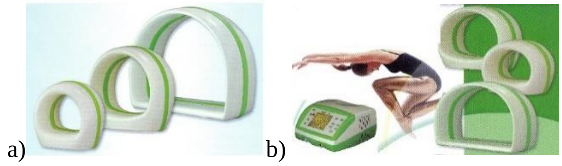

Figure 2: *Application of Applicator:a) AS-200N, AS-315N, AS-600N [26],b)gymnastic implemented by Applicators*

• Another apparatus is PEMF-MAGCELL-ARTHRO presented in Fig.3 with recently applied treatment in knee osteoarthritis after proper gymnastic training [1,5,9,11,24].

Figure 3: *Application of German electronic device:a).Pulsed Electro Magnetic Field (PEMF) Magcell Arthro Thera-py Device, b) gymnastic implemented by Magcell Arthro,c) two sports-women treated by the PEMF*

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 and 12 Hz. The Magcell device produces time varying magnetic induction field of about 105 mT flux density [3],[9],[11].The PEDOMETER GARMIN LTD.2015 electronic device with the vivofit band is presented in the Fig.4.Such setting is paired and downloaded using a computer with Windows and complete the setup.

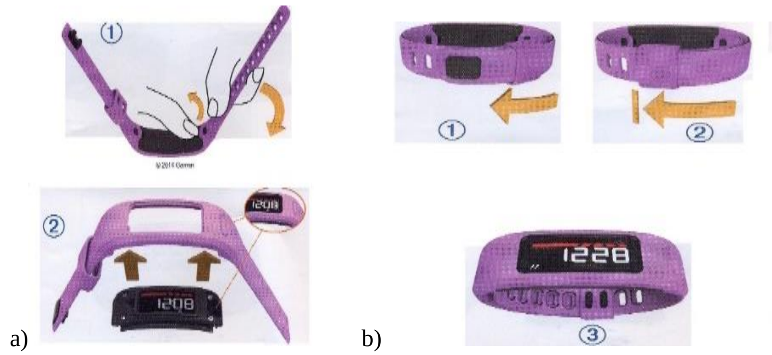

Figure 4: *Electronic pedometer Garmin LTD 2015:1,2-water proof pedometer vivofit band and pedometer montage;3-pedometer with montaged band;*

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

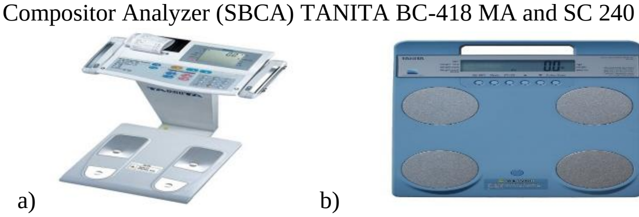

Figure5: *Segmental Body Composition Analyzer:a)SBCA,BC-418 MA, b)SBCA,SC-240*

SBCA, BC-418 MA presented in Fig.5a consists of 5 body segments, namely: the trunk, the left arm, the right arm, the left leg, right the 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.

SBCA, SC-240 presented in Fig.5b has a clear body composition monitor. The device is light (about 4.53kg) and highly portable with a built-in handle. It has a large platform (43.7cm×34.2cm) 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 %, 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 [29].

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 (PL) or the sportsman`s skin.The PL-bilayer lining the negatively charged hydrophilic cartilage surfaces in various human natural joints are presented in the Fig.6.[1,2].

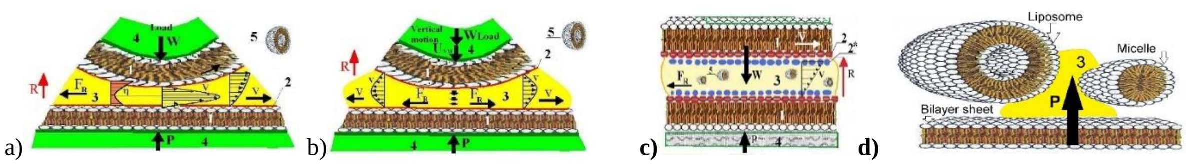

Figure 6: *The joint gap limited by the various shapes of the phospholipid (PL) bilayer, a) the elliptic or spherical shapes of the PL bilayer in lubrication by rotation,*

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(2nm hight),2-hydrated –PO4− 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,FR-Friction force,η-viscosity distribution of synovial fluid

•PL-bi-layers lining the negatively charged hydrophilic cartilage surfaces with hydrodynamic pressure P in the human natural hip joint presented in Fig.7a can be supplied by external PEMF [6] and AE sound intensity. 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 Fig.7b.The sweat flow, heat flux in the thin gap between human body skin and the tightly fitting dress illustrates Fig.7c.Woman tightly fitting sport dress shows Fig.7d. Bio-sweat, flows with shear rate □□500/s on the internal dress surface presented in Fig.7e. By virtue of measurements and dynamic viscosity numerical calculations from hydrodynamic and constitutive equation, we illustrate in Fig.7e,for temperature T=297K, that the absorbability (wettability) increments (from We= 70°→to We=50°) of the internal dress surface, imply on the bio-sweat dynamic viscosity decrements (from η=0.0050 Pas →to η=0.0030 Pas). Horizontal, Wettability scale is presented in grade of the angle between tangent line to the bio-sweat drop surface and horizontal lubricated dress surface [8].

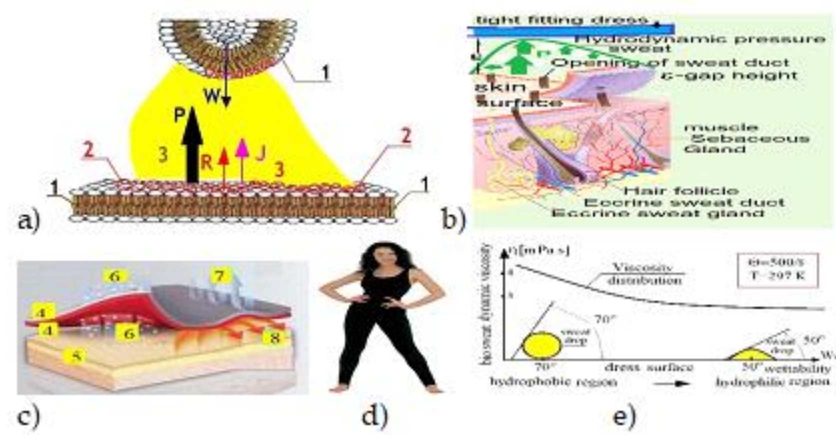

Figure 7: *The effects of hydrodynamic pressure: a)Pulsed electro-magnetic fields(PEMF) from external device into the phospholipid membrane lying on the cartilage superficial layer for squeezing lubrication, b) Sweat lubrication between skin and tight fitting dress surface, c) movable non-rotational (skin-sweat-sport dress),d)two-piece thin elastic woman dress, e) bio-sweat dynamic viscosity versus wettability of the internal dress surface.Notations:1-PL bi-layer,2-lipids with negative charge,3-SF-synovial fluid,4-sport dress,5-human skin, 6-sweat pressure, 7-sweat outlet, 8-heat flux; R-repulsion force, J- AE sound intensity and current density supplied from PEMF-MAGCELL device*

The joint gaps in Fig.7a are limited by the upper and lower phospholipid membrane (PL-bilayer) 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 bilayer 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 43mA/m^2 [24] and it generates repulsion forces as it gives important SF viscosity increments suitable for osteoarthritis treatments [1,3,9,11,24]. The load force W of the presented human joint, has in general the reverse sense.

The Fig.7b, Fig.7c, Fig.7e show the phenomenon of hydrodynamic pressure after sweat lubrication in the thin gap between the movable external skin surface and a tightly fitting dress surface without phospholipid bilayer (PL). Fig.7e shows two drops of bio-sweat which are resting on the horizontal internal dress surface. The human training sweat produced by the Gland Sweat African (GSA) includes about 100 % more lipid-proteins, than sweat produced by the Gland Sweat European (GSE). Hence sweat viscosity from GSA is about 50% larger than sweat from GSE.

● On the left side in Fig.7e, the spherical drop surface of the bio-sweat has very small contact with the horizontal internal dress surface. Hence the penetration→ absorbability (wettability) of the bio-sweat into the dress surface, is very small. In this case the grade of the angle between tangent line to the bio-sweat drop surface and horizontal lubricated dress surface, has value 70º.Hence in this place we have hydrophobic features of the dress surface and in this point, we denote wettability We= 70º.

●On the right side in Fig.7e, the parabolic drop surface of the bio-sweat has very large contact with the horizontal internal dress surface. Hence the penetration absorbability (wettability) of the bio-sweat particles into the dress surface, is very large. In this case the grade of the angle between tangent line to the parabolic bio-sweat drop surface and horizontal lubricated dress surface, has value 50º.Hence in this place we have hydrophilic features of the dress surface and in this point, we denote wettability We= 50º.

●Increments of the dress-surface wettability illustrated in Fig.7e, denote the transformation from the hydrophobic (small absorbability dress-surface with 70º) to the hydrophilic (large absorbability dress-surface with 50º) features [8].

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:3.1-theoretical methods,3.2 -experimental methods, and 3.3- 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 [4,10,20,21,22].

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 and AE therapy.

The loss weight methods of human body are referring to indicate the way of the human sliming process caused indirect by the electro-magnetic field and AE therapy. 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.

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 [4,8,10].

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 [4].

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 [23].

During the electro-magnetic therapy, we have two possibilities of the e-m field activity. The first possibility refers to the case when the e-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 [23]. And hence follows the slim effect connected with the loss of the human body weight. Such a process is presented in Fig.8a.

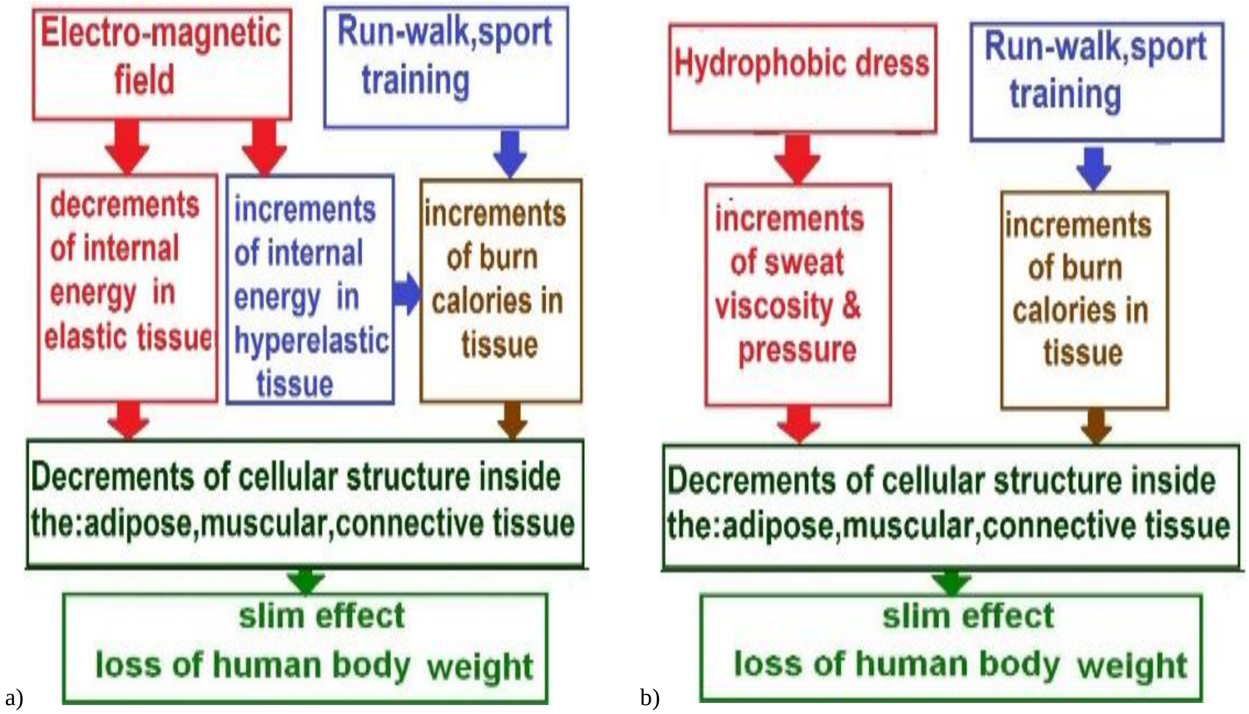

Figure 8: *A view of the sliming process of human body tissue: a) after e-m field, b) after hydrophobic dress*

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

On the metabolic and slim process has influence additionally the wettability of the internal dress surface. If the internal dress surface is hydrophilic i.e. has large wettability, then sweat dynamic viscosity is very small (0.003Pas).

If internal dress surface is hydrophobic i.e. has small wettability, then sweat dynamic viscosity attains very large increments (see Fig.7e). Large value of the sweat dynamic viscosity during the run and walk implies the large value of hydrodynamic pressure and desirable capacity (see Fig.8b). This fact leads to the decrements of the cellular structure and slim process. Hence internal surface of the tightly fitting dress must be more hydrophobic than hydrophilic.

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

Experimental methods

Three young girls are taken into account with following data [23]:

U-18 years old, height 1.57m, weight 69kg, i.e.BMI=27.99;

V-19 years old, height 1.61m, weight 74kg, i.e.BMI=28.54;

W-20 years old, height 1.62m, weight 75kg, i.e.BMI=28.57;

Segmental Body Composition Analyzer (SBCA) TANITA BC 418 MA applied for student-girls U,VW gave the following data presented in **Table 1**:The Tanita SBCA provide the most accurate and detailed data in bioelectric impedance testing .(author`s own research).

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

Experimental method is based on the sport training effects obtained for selected U, V, W healthy girls 18,19,20 years old, similar heights and with the similar SBC (Segmental Body Composition) data presented in **Table 1**. The number 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.

4. Results

Experimental Results obtained after walk,run training without AE

The run and walk of each girl U, V, W was performed twice daily for 60 minutes a total of 25000 steps over a distance of 18km 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 about15Hz and a magnetic induction of about 70 mT [18],[23]. The training effects in the form of SBC data from the analyzer BC-418-MA for student-girls U, V, W are presented in **Table**2.

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 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)*

Percentage SBC data obtained after training (Table 2) in comparison (in relation) with the corresponding data before training (Table 1) are presented in **Table 3** for girls U,V,W

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%

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

Electro Magnetic (EM) therapy for various diseases aided with run or walk without AE

In this section,the hypothesis is examined that the EM 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 [23].

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.

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],[28].

In general the magnetic induction field is perceptible and noticed if its value is greater than the Earth magnetic induction field i.e. about 30-70μT ($T=kg/s^2A=Wb/m^2$) [18,23,25].

Disease with requi-red walk, run steps number	**localization**	**Magnetic induction**	**Frequen cies**	**Shape of field lines**	**Treatments duration Using 24-MT or (PE MF MAGCELL AR-THRO Apparatus)**
1.Degeneration changes, inflammation of vertebral joints,disc diseases /every day 10 000 steps	Lumbar vertebral column	20-10mT	10-20 Hz	Triangle or rectangular	Once a day, 15 minutes (twice daily for 5 minutes, together 10 minutes) per 18 days,
2.Limb joint diseases/every day 8000 steps	Hip joint	20 mT	20Hz	Triangle	Once a day, 12 minutes (twice daily for 5 minutes, together 10 minutes) per 21 days
3.Limb joint diseases/every day 12000 steps	Shoulder joint	15 mT	20Hz	Rectangular	Once a day, 12 minutes (twice daily for 5 minutes, a total of 10 minutes) per 21 days
4.Limb joint diseases/ every day 12000 steps	Knee, Elbow, Phalange joint	15 mT	20Hz	Rectangular	Once a day, 12 minutes (twice daily for 5 minutes, together 10 minutes) per 21 days
5.Osteoporosis, Osteoarthritis/every day 8000 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

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. Attention: Data in parenthesis are refer to the treatments duration performed by Magcel Arthro Apparatus without AE [9,18].*

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%.

Results obtained from experiment and anamnesis without AE

Now we proceed to the data obtained after individual anamnesis on the grounds of the data values manifested in Table 4 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 &2 for the same five typical diseases and its localization in human body numbered by 1,2,3,4,5.

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

Table. 5: *Anamnesis results of the evaluation of efficacy deduced after magnetic therapy presented in Table 4 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. Attention: Data in parenthesis refer to the treatments performed by PEMF Magcel Arthro Apparatus and implemented by the indicated run-walk without AE.*

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 minutes for all. Upon pressing the start button in PEMF Magcell Arthro Apparatus (see Fig.3) the device ran and stopped automatically after 2 minutes and 30 seconds. We make this operation two times consecutively. After the first treatment, the area was changed 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.

Results from experiment, calculations and anamnesis with AE,without E-M field

●The main unit of acoustic Emission (AE) is sound intensity denoted by J in W/m^2. The dimensionless sound intensity level L of the AE therapy is defined as the fraction $L=J/J_{pmax}$ of the sound intensity J for the actual measured bio-sample, to the maximum value of sound intensity J_{pmax} existing for performed measurements in pathological bio-sample. The reference sound intensity in air has the value: $J_0=10^{-12}W/m^2$. Taking into account dimensionless value $J/J_0=10$, we define the following essential sound unit's bel in the form: 1B= one bel= 0.5 ln (10) =1.1512…., and 1dB = decibel=0.1 B. In AE therapy the interval of the sound unit measured in decibels attain values from 0 to 100dB. If in the wave of AE increases the sound intensity, then increases the contact between environment air, sweat, bio-liquid particles. Hence increases the friction force between contacting particles [25]. Thus, increases the dynamic viscosity in the mentioned bio-fluid particularly Synovial Fluid (SF) particles. The AE sound intensity is usually direct proportional to the square of AE wave amplitude. By virtue of mentioned remarks, the AE has influences on the human metabolism, but additionally can be used as the therapy as the diagnosis tools (see Fig.9ab).

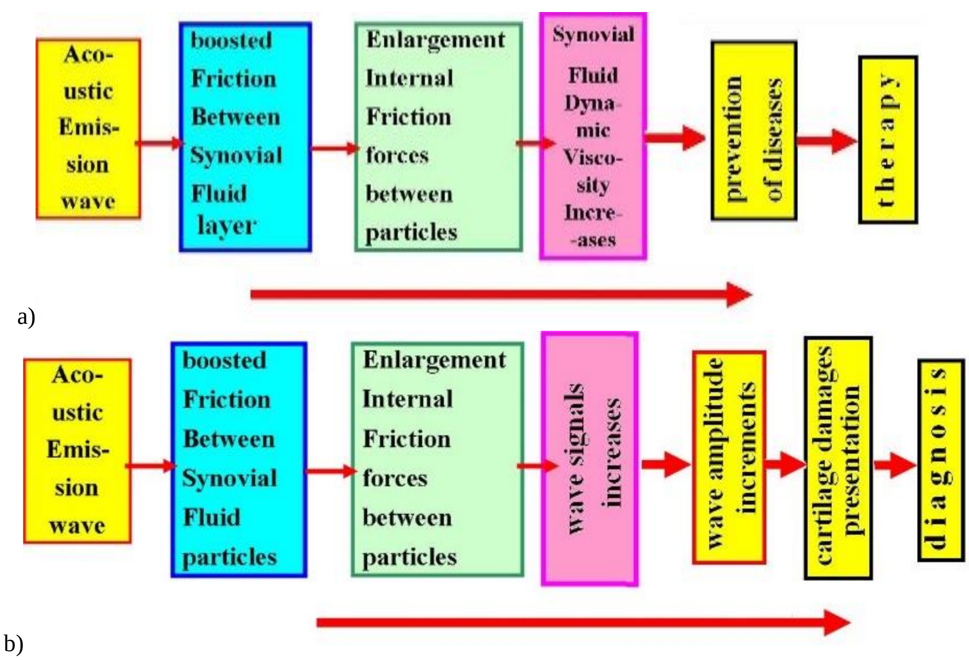

Fig.9.*Two possibilities after AE treatment in logical implications of resulting steps: a) for therapy, b) for diagnosis*

The results obtained on the ground of AE treatments are presented in **Table 6**. Table 6 illustrates the applications and influence of following AE-therapy parameters: sound intensity waves level, frequency, amplitudes, number of testing joints, kinds of joints, kind of location, distribution for joint surface diseases on the anticipated diagnosis [25].

Number of patients	**Number of samples and the human joint**	**The sound intensity level L of AE waves**	**The average frequency of the AE waves**	**The average amplitude of the AE waves**	**Anticipated diagnosis with the necessary data about human joint cartilage surface**
10	10 knee or hip	0.05	4 kHz	0.5 μm	Normal non-defective cartilage surface
29	29 hip	0.21	20 kHz	2 μm	Normal cartilage with the small used places on the surface
10	10 knee and hip	0.39	40 kHz	3-4 μm	Pathological cartilage with a few arthritis defects on the external surface
10	10 knee	from 0.25 to 0.60	79 kHz	2-7 μm	Pathological cartilage with osteoporosis defects
10	10 knee	0.64	80 kHz	9 μm	Pathological cartilage with a large arthritis defects on the external and internal surface layer
29	29 hip	0.83	100 kHz	9 μm	Pathological cartilage with average large defects caused by the rheumatologic inflammation
29	29 hip or knee	1.00	150 kHz 100%	10 μm	Pathological cartilage with very large defects caused by the rheumatologic inflammation or arthritis defects on the external and internal surface layer

Table 6: *The matrix of necessary conditions for AE diagnosis problem without E-M field*

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 Electro-Magnetic (EM) and AE therapy.

General remarks

The EM and AE field increases the dynamic viscosity of Synovial Fluid (SF) during the cure, treatment, and during the run, walk training. SF 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 phospholipid (PL) membrane in human joints and enlarged with the external EM particularly Pulsed Electro Magnetic Field (PEMF) are visible if two effects particularly in the presence of boosted squeezing and weeping joint lubrication, and if we have mutually influences of the Power Hydrogen (pH) ion concentrations after a dissociation process in the joint gap and proper electric charge on the superficial cartilage layer.

The 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 PEMF effects.

The 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 HMA and with BMR values in Kcal occurring after run or walk without PEMF effects.

The PEMF without AE 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 PEMF and AE effects.

The classical magneto-therapy for the hip, knee, shoulder, elbow and human joint implemented by the PEMF without AE 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 or AE effects and without run or walk training.

Particular conclusions

The hydrodynamic pressure and load carrying capacity caused by the sweat lubrication, occurring in the gap between human skin and dress, has the influence on the metabolic process after following effects:

a)The Segmental Body Computer Analyzer (SBCA) values obtained after training for girl-student U,V,W indicate that the decrements of the BMI index, external and internal body fat, HMA values are larger in the case when the tightly fitting dress was used (see column V & W) in comparison with the abovementioned decrements for the loose dress (see column U).

b)The SBC values obtained after training for girl-students U,V,W indicate that the increments of the water, muscle mass, BMR index are larger in the case when the tightly fitting dress was used (see column V&W) in comparison with the abovementioned increments for the loose dress (see column U in Table 3).

Further effects of BMI-index decrements and BMR-index increments are anticipated in the next researches, by using the tightly fitting dress during the run and walk.

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