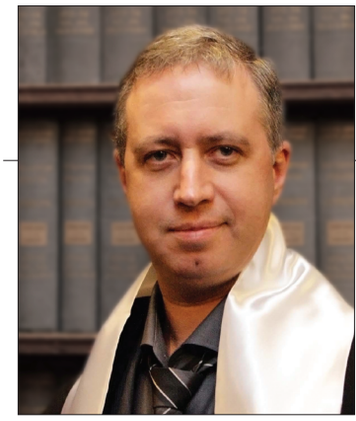

The Treatment of Some Inflammatory–Degenerative Pathologies of Joints by Intro–Articular Joint Cartilage Formation

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In orthopedic and trauma practice occurs a number of pathologies, therapeutic treatment which is ineffective, and surgery for various reasons is undesirable. Such diseases include chronic polyarthritis, deforming arthrosis 2-3 stage, meniscus injury, and so on.

The technical result is achieved using a method of treating inflammatory and degenerative pathologies by intra-articular joint modeling is the high efficiency of therapy, allowing to achieve a complete cure, able to avoid surgery, including joint replacement, the possibility of outpatient treatment, the absence of contraindications.

The inventive effect is achieved in the implementation of a method for treating inflammatory-degenerative pathologies of joints, comprising the fact that the treatment is carried out in three stages, the first of which is conducted in at least one course of combined therapy aimed at suppressing the inflammatory response and pain relief. The second stage is used, at least one session focused extracorporeal shock wave therapy Ultra High Power, aimed at creating a thicker cartilage microcavities that the third stage is filled with modeling compound, which is used as a mixture of 15 parts of particulate biopolymer gel, 65 parts of hyaluronic acid, 15 parts of the extract of animals cartilage and 5 parts of Dimexidum solution, and filling is carried out by intraarticular microcavities electrophoresis followed by stabilization via noninvasive pulsed infrared laser with a high-with a wavelength of 785 nm, while ensuring the heating of the filling simulator to 44 degrees Celsius.

The main difference of the method for treatment of inflammatory and degenerative pathologies by intra-articular joint modeling from other known methods is to create a micro-cavities in the intra-articular cartilage, and then fill the cells by the modeling structure and stabilization of the resultant structure, to achieve full recovery of shape, volume and consistency of the normal intra-articular cartilage.

Combined therapy at the first stage of treatment includes microwave heating of the musculo-ligamentous apparatus of

the affected joint, ultrasound therapy and drug anti-inflammatory therapy.

Microwave heating of the musculo-ligamentous apparatus of the affected joint is electromagnetic radiation between radio waves and infrared at a frequency of 30 GHz 300MGts. In medicine uses three frequencies and microwaves respectively three lengths: 2450 MHz (12.245 cm), 915 MHz (32.79 cm) and 433.9 MHz (69.14 cm). In Europe, the use of all three frequency microwave therapy in the US - only the first two.

For the electromagnetic field of the microwave magnetron vacuum is used, combining the functions of electronic valves and oscillating circuit. The electron source is a magnetron cathode. The electric field between the cathode and anode accelerates the electrons. Small-sized permanent magnet, which is equipped with a magnetron, produces a magnetic field directs the movement of electrons. The electromagnetic field of the microwave supplied to the tissue via special directional emitters which constitute the dielectric antenna. Radiators are used for contact and remote methods of exposure. When the remote unit is set in the exposure screened cabin, so that the emitter is directed towards the outer wall.

Microwave energy is mainly absorbed by water molecules, the permeability of the dielectric in connection with this small. When exposed to microwaves in the centimeter range dipoles of water have time to turn around completely for one sign change polarity. Absorption of energy occurs primarily in tissues rich in water. Largely reflect their skin surface, take into account that at a dose procedure is not possible. Depending on the thickness of the subcutaneous fat layer and the emitter is reflected location features 25 to 75% of microwave energy, on average about 40%. Much a reflection of their interfaces from other tissues: skin - subcutaneous fat, subcutaneous tissue - muscles. Thus, the formation of so-called "standing" wave in the tissue. They are formed when a wave is reflected from the boundary between two media, and the imposition of the reflected to the next incident wave. According to the laws of physics "standing" wave is formed in the case, if the distance between the boundaries of the two media is more than a quarter wavelength. This situation can occur when the thickness of the subcutaneous fat layer more than 2 cm.

Microwaves (UHF-therapy) is about twice less intense reflective surface of the skin. They are less than a centimeter wavelength range absorbed by water, since the phenomenon of resonance of dipoles of water at this frequency electromagnetic fields are less pronounced. The energy of these waves as the penetration depth of the tissue dies twice as slow compared to centimeter waves. Warming tissue UHF therapy occurs at a depth of 3 cm. In the formation of "standing" waves are significant local increase in tissue temperature up to burn. This overheating of tissue accompanied by a feeling of fullness, burning, bursting pain that requires immediate dose reduction or cessation of exposure procedures.

Physiological effects of exposure to microwave treatment on a living organism are to improve the metabolic activity of cells, reducing the viscosity of all liquids, increasing the extensibility of collagen, increase blood flow, effective impact on the nervous system.

The therapeutic effect of microwave radiation is shown as an anesthetic (due to the direct effects on pain gate, accelerated removal of irritants and by increasing blood flow, reducing muscle spasms, sedation), reduction or complete cessation of muscle spasm due to direct effects on muscle spindle-shaped structure, the acceleration recovery by increasing the metabolic activity that has an impact on post-traumatic process and course of chronic infection, softening of collagen tissue, scar tissue and other fibrosis, treatment of muscle tissue by increasing intramuscular blood flow.

On the oscillatory effect associated anti-inflammatory effect of microwaves, anti-allergic effect, a positive effect on immunegenesis. Despite the fact that the action of the microwaves spread in a small volume of tissue, the overall reaction can be observed. They are implemented mainly through strengthening the function of the parasympathetic division of the autonomic nervous system: lowering blood pressure, slowing of the heart rate, slowing intraventricular conduction in the heart. Stimulation of synthesis of some prostaglandins.

With the thermal effect of microwaves connected analgesic effect, the intensification of blood and lymph circulation in the tissues, the intensification of metabolism. It should be remembered that the oscillator and thermal effects are inseparable and are shown simultaneously.

Ultrasound is a form of mechanical energy and represents the mechanical vibrations of an elastic medium frequency greater than 16 kHz, which are not perceived by the human ear. These vibrations are transmitted as a longitudinal wave causing alternating compression and rarefaction of the medium or material.

The greater the power of the transmitted energy, the greater the amplitude of the deviations of the particles of the medium on the initial state. The distance includes a compression region and a vacuum region is a wavelength which is inversely proportional to the oscillation frequency.

Low frequencies ultrasonic waves are propagate spherically with increasing oscillation frequency and accordingly, reduce the wavelength of ultrasonic beam becomes straightforward. Rectilinear propagation of ultrasonic waves of high frequency (800 - 3000 kHz) is responsible for their use in physiotherapy. These waves propagate parallel to each other, they can be concentrated in a limited area. Absorption of ultrasonic waves varies in different tissues. For example, the absorption coefficient for the ultrasonic bone 12-15 times higher compared to the muscle tissue. In general, the higher the oscillation frequency, the more intense the absorption, the less the penetration depth. High frequency ultrasound intensely absorbed by the air.

His slightest layer between the emitter and the surface of the skin retain ultrasonic waves. In this regard, the therapeutic effect using airless contact medium: petrolatum, glycerin, lanolin. In those cases

where not possible contact between the ultrasound transducer and the skin surface (area of hand, foot), exposure is performed remotely through the water with a gap of 1-2 cm. For ultrasound using a reverse piezoelectric effect.

Under the piezoelectric effect to understand the phenomenon of electric polarization of crystals caused by their mechanical deformation: compression, tension, bending, torsion. These properties are quartz crystals of barium titanate and others. On the other hand, by placing the crystals in a variable electric field, they are stretched and compressed, depending on the field direction. The frequency of the received mechanical oscillations corresponds to the frequency of the electric field. Thus, the apparatus for obtaining ultrasonic generator comprises an ultrasonic high frequency transducer (vibrator applicator) in which is placed the plate barium titanate or quartz.

Ultrasonic emitter tightly pressed against the surface of the skin in the affected joint or, if not possible close contact, the remote wire exposure through water. Remote method is used in cases when the treated surface of the body has a complicated shape (fingers and toes) or larger surface area. For this purpose, a glass or ceramic cuvette filled with water or a drug solution, the entire portion of the body is placed, which is intended to be subjected to ultrasonic radiation. Then immersed in the water a source of ultrasound (emitting head) and include ultrasonic wave generator.

Basic biophysical processes in tissues associated with the three main effects of ultrasound: mechanical (mechanics and dynamic), physico-chemical and thermal.

Mechanical action is manifested at the cellular and subcellular levels. The impact of high-intensity ultrasound leads to rupture of tissue with the formation of microscopic cavities, the existence of which is comparable with the period of ultrasonic vibration. The mechanical action of the low intensity ultrasound that is used in physiotherapy is vibrational micromassage tissues. In this case, cells and tissue structures amplified diffusion and osmosis processes.

Physico-chemical activity of ultrasound is associated with complex electron quantum phenomena at the molecular level. Accelerating the movement of molecules, increasing the formation of ions. In tissues increases the number of free radicals, activate the formation of biologically active substances and redox reactions, increased dispersion colloids cells. In therapeutic ultrasound dosages is the catalyst of biochemical reactions.

Thermal effect associated with the conversion of mechanical energy into heat, and it comes to endogenous heat. Heat is produced primarily in the tissues rapidly absorbing ultrasound: nervous tissue, bones. Is heated throughout the tissue is the volume heating, heat is generated as the boundary between two media of different acoustic density - structural heating. As used in physiotherapy small intensity ultrasound noticeable increase tissue temperature during treatment is not observed. Thermal effect in this case, plays a secondary role.

Depending on the applied dose can be observed damaging, depressing and stimulating effect of ultrasound. In physiotherapy using doses which cause a stimulating effect without causing destructive changes in the tissues. To determine the optimal frequency, power and duration of radiation treatments are standard tables for physical therapy ultrasound, wherein the dose of radiation depends on the depth of the surface area and the pathological focus.

Depending on the depth of the chamber and its surface should apply a different power and irradiation time. The depth of tissue penetration of ultrasound frequency of 800-1000 kHz is estimated at 5-6cm, frequency of 2400 kHz - three times less. Best ultrasound penetrates into the fatty tissue of the nervous and muscular delayed. A significant number of ultrasound is absorbed at the interface tissue with varying acoustic density. From bones reflect 60% of the incident ultrasound energy. In small subthreshold doses ultrasound can penetrate to a depth of 20 cm as the data visualization of reflected waves from this depth. This fact is used in the ultrasonic diagnosis.

Physiological responses associated with the main biophysical effects are closely intertwined and interact. At therapeutic doses, ultrasound has a generally stimulating effect on cell function. In the initial phase effects observed swelling of mitochondria, variations in the structure of the matrix structure of cell shape becomes blurred.

Irritation of cells leads to activation of its activity, strengthening the respiratory activity of mitochondria. In general, there is a biological effect of stimulation, which lasts for several hours after a single exposure. Higher doses cause abrupt changes in cellular microstructures inhibit the activity of cells, there are signs of the damaging effect.

Under the influence of ultrasound on the connective tissue is observed rejuvenation of its cellular and fibrous structures. There are cells with abundant cytoplasm represented mainly substance increases the amount of elastic fibers and collagen formation is inhibited. When exposed to excessive connective tissue with ultrasound has restructured, that makes more elastic scar.

Low intensity ultrasound accelerates regeneration of damaged nerve fibers, reduces the sensitivity of receptors, which is manifested analgesic effect. The ultrasound acts on the receptor apparatus of the skin without causing any noticeable subjective sensations. Most sensitive to its effects, facial skin and stomach.

Impact on skin receptors specific reflex zones leads to the common responses that are realized through higher autonomic centers of the hypothalamic-pituitary system. According to this mechanism of action of ultrasound therapy increases the lability of the nerve centers and the adaptive-trophic functions of the whole organism. In some medical procedures used is the total effect of ultrasound.

Anti-inflammatory therapy is to appoint a course of non-steroidal anti-inflammatory drugs (Voltaren 75mg x 3ml) by intramuscular injection 1 ampoule 3 times a week, but not more than 10 ampoules for the entire course of treatment.

The success of the first phase of treatment is determined by the results of repeated ultrasound images of the affected joint, which is determined by the dynamics of change in the severity of soft tissue swelling. In some cases, during the shots may be necessary magnetic resonance imaging (MRI).

In the second phase of treatment is used, at least one course of adjuvant therapy, aimed at creating a thicker cartilage microcavities, which will later be filled with modeling compound. A similar effect is achieved by using a focused extracorporeal shock wave therapy Ultra High Power (F-SWT).

Focused extracorporeal shock wave therapy is based on short-time (0.5 seconds) discharges of the low-frequency sound wave shock, which loosens the lime and fibrotic lesions that cause inflammation and pain, and also forms microfractures in weakened sections of cartilage degeneration.

By the power of radiated energy shock wave therapy can be subdivided on the low-energy (1-2 MPa, is mainly used to perform physiotherapy) regular (3-5 MPa is applied for the treatment of musculo-ligamentous apparatus), high-energy (up to 10-15 mPa is applied for the treatment of protrusions and herniations of intervertebral discs) and ultra-high-power (from 15mPa above, is used to destroy kidney stones and gall bladder, as well as describing the methods of treatment of joints).

F-SWT is based on creating a shock wave with a high flux density, which focuses on a limited target area. This is to ensure that the shock waves develop full power only in a selected area for treatment without harming the surrounding tissues. Hyperbaric effect of F-SWT based on the ability of the acoustic vibrations form a void in the tissues as a result of which a liquid to a gas and leaving it out. This component therapy F-SWT is crucial in the treatment of hastily-degenerative joint disease. Thus, the effects produced on the fabric, leading to deformation of the cell membranes by mechanical impact shocks.

Parameters determining successful extracorporeal therapy mainly are the energy and power density. These parameters depend on the degree of intra-articular cartilage degeneration and are selected for each patient individually. Mechanical or acoustic energy of the shock wave is determined by the amplitude of the pressure and its duration, the acoustic properties of the medium (density and acoustic velocity) and the spatial distribution of the shock wave. To achieve a noticeable effect in the tissue, the energy of the shock wave must be limited accurately focused on the target area, where it exceeds the threshold value, and will produce a therapeutic effect. It is believed that shock waves are effective if the pressure is 200 bar (20 MPa) or more. This zone corresponds to the so-called focus 20 mPa.

F-SWT is at the threshold energy, selected from the range of 15-25 MPa. In this case, the optimum is considered to be a way to find a course of F-SWT when one session microcavity formed in 10-15% of the mass interarticular cartilage that can be tracked by results of US joint. The energy of F-SWT settings during the treatment, and pulse frequency (0.5 to 20 Hz) is determined by the doctor depending on the dynamics of the therapy. If the patient begins to experience pain even when properly focused shock waves flow, reduce their energy at 2.0-5.0 MPa. It is also possible to reduce the pulse frequency 1-5 Hz. Practice shows that in most cases this is enough for a relatively small decrease in the effectiveness of therapy. For maximum effect, wave penetration into the tissues of the body, it is desirable to use the gel conductors, such as conductive gel for ultrasound therapy / diagnosis. During the procedure, the head of the emitter F-SWT tightly pressed against the surface of the joint, moving slowly so as to focus the radiation always been concentrated in the affected cartilage.

As mentioned above, the rate of F-SWT consists of a large number of sessions. To create the desired amount of microvoids in cartilage tissue may require from 3 to 20 treatments. It is absolutely necessary to perform the control ultrasound images of the joint to be treated every 5-6 sessions to manage the process of loosening cartilage. Completion of the second phase must also be accompanied by a study using magnetic resonance imaging (MRI).

The third stage of treatment is used to fill of microcavities interarticular cartilage tissue and stabilization derived cells with a laser. Due to the fact that the amount of composition filled microwells volume exceeds microcavity blank after completion of the simulation screen in the cartilage is increased to 70-75%, but the method of treating joint cartilage does not increase the thickness more than 50-60%, otherwise, it may affected the structural integrity of the cartilage due to the expression of heterogeneous tissue.

Simulating composition as a mixture of 15 parts of particulate biopolymer gel, 65 parts of hyaluronic acid (in the form of preparations on its basis: preparation Osteonil, Fermatron, Synovisc, Duralan), 15 parts of the extract of cartilage from animals and 5 parts of a solution Dimexidum. The resulting sterile formulation introduced directly in the affected joints, evenly redistributed in thickness interarticular cartilage filling the microcavities. After simulating composition impregnate and fill the cartilage microcavity that is determined by the results of the ultrasound images of the joint, carried out by means of stabilizing the infrared high intensity laser having a wavelength of 785 nm.

At the heart of bio-stimulating effects of laser radiation in the red and infrared processes are active molecules capture light particles - photosensitizers, transporting energy to the negative form of the molecule, followed by a break ionic bonds in them, and the formation of free ions. Simultaneously, there is increased permeability of the cell membrane to ions and enzymes, thereby increasing the bioenergetic activity of cells in protein, nucleic and lipid metabolism. Upon absorption of laser radiation, it is completely transformed into thermal energy. As a result, thermal expansion of the cytoplasm, activation of various enzyme systems, and possibly change the visco-elastic properties of the membranes which serve as natural boundaries between phases in a biological space. These changes at the molecular level may provide an impetus for deeper secondary effects.

Infrared absorbing fabric entirely transformed into thermal energy of vibration of the molecules. Thermal expansion of protoplasm can

determine the hydrodynamic effects that are common initial pulse infrared laser action. Even short-term increase of temperature fluctuations in the critical areas of the molecule leads to its transfer to a new conformational state of the other reactive. Photoactivation in complex biological objects such as humans, there is a multistage process.

In the human body, in addition to specialized photoreceptors, there is a lot of photoreceptors with universal properties. These include hemoglobin, having different absorption bands in dependence on the state at or hydroxy desoxy: porphyrins, cyclic nucleotides, iron and copper-containing enzymes (catalase, superoxide dismutase), enzymes redox cycle, cytochromes, pigments and other substances. The intensity of the laser irradiation is determined both by the nature of the radiation (wavelength, power density, exposure, modulation frequency and amplitude, etc.) and the properties of biological systems. The penetration depth of the laser beam in biological objects depends on the wavelength of the radiation and methods of exposure (contact, Distant). The penetrating ability of radiation increases gradually from orange to ultraviolet spectral region.

The nature of the laser radiation on biological objects depends on the length and the laser power. Under the influence of laser radiation on bone activates the regeneration of bone tissue in the form of accelerated proliferation of osteoblasts and osteoclasts while enhancing cell differentiation; increase of bone calcium, phosphorus and protein, increase bone volume, bone tissue vascularization.

Under the influence of the laser radiation of low intensity at the articular cartilage observed anti-inflammatory effects of laser radiation, increased fibrinogen levels, proliferation of fibroblasts. The positive effect of laser therapy in deforming arthrosis and arthritis expressed in the elimination or reduction of pain, normalize or increase the range of motion in the affected joint, the disappearance of stiffness and facilitate walking.

All methods of laser therapy used to treat patients with orthopedic and trauma profile can be divided into two major groups - invasive laser therapy (made in violation of the integrity of the tissue) and non-invasive (without compromising the integrity of the tissue). The most commonly used externally (percutaneous) laser therapy. Irradiation is carried out in the fields, zones, acupuncture points. Use options stable (stationary) and labile (laser beam scanning) method. Irradiation may be carried out by a focused and defocused laser beam through air, or through a liquid medium. Furthermore, it is possible to allocate a distant (with a certain gap between the skin and the transducer) and the contact (without gap) effects.

When the contact radiation exposure using fiber or radiating head is applied directly to the skin without any gap between them. Distinguish contact, contact with compression (dosed pressure on the skin or the emitting end of the fiber head) and contact-mirror effects (on both sides of the fiber has a reflecting mirror). To enhance absorption of laser radiation (in pathologically altered tissues) may use some dyes in colored areas as the absorption of the laser energy in the red range is increased to 60-70%, which, naturally, increases the therapeutic effects.

In the described method for the treatment of inflammatory and degenerative pathologies of joint used noninvasive pulsed irradiation of high-energy infrared laser with a wavelength of 785 nm and emission power of 7-10 W at a pulse duration of 0.5 seconds and a pulse frequency 1 Hz. The purpose of this manipulation - heat the filling microcell modeling the composition of up to 44 degrees Celsius. At this temperature inside the microcell microscopic droplets merge fine biopolymer gel in large vacuoles. After cooling, the modeling composition to normal for a person within the joint temperature of 37-38 degrees Celsius, each microcell is filled with modeling compound, is securely held inside the cartilage drops biopolymer gel. During the manipulations necessary to carefully monitor the temperature of the cartilage as measured by infrared thermometer. If the heating is too rapid cartilage must either reduce the radiation power of 1-2 watts, or to increase the interval between pulses of 1-2 Hz, or to reduce the pulse duration of 0.2-0.3 sec. After each manipulation is necessary to monitor the result with the help of ultrasound images of the joint.

The described method for the treatment of inflammatory and degenerative pathologies by intra-articular joint cartilage modeling offers an exceptionally high performance even in the third stage of arthritis, are inconclusive when all other methods of conservative treatment. At the same time, this method avoids surgery for joint replacement, until recently, was considered the only way to treat with severe intra-articular cartilage degeneration. According to statistics obtained by the Israeli clinic «Pain Clinic» on the results of 13 years of experience in conducting more than 14,000 patients with different pathologies of the joints, the effectiveness of treatment by intra-articular cartilage modeling approaching 95% clinical and laboratory confirmation of a positive result.