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Emission of Biophotons and Adjustable Sounds by the Fascial System: Review and Reflections for Manual Therapy

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Abstract

Every body structure is wrapped in connective tissue or fascia, creating a structural continuity that gives form and function to every tissue and organ. The fascial tissue is uniformly distributed throughout the body, enveloping, interacting with and permeating blood vessels, nerves, viscera, meninges, bones and muscles, creating various layers at different depths and forming a tridimensional metabolic and mechanical matrix. This article reviews the literature on the emission of biophotons and adjustable sounds by the fascial system, because these biological changes could be a means of local and systemic cellular communication and become another assessment tool for manual (therapy) practitioners. This is the first article that discusses these topics in a single text, attempting to bring such information into an area of application that is beneficial to osteopaths, chiropractors, and manual therapists.

Keywords

fascia, myofascial, osteopathic, manual therapy, biophotons, muscle

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The fascia is one but, at the same time, it is always different. At present, there is no single definition of fascia, probably due to the scientific mark made by each professional figure in attempting to create a single point of view.[1-7]

Every body structure is wrapped in connective tissue, fascia, creating a structural continuity that gives form and function to every tissue and organ. The fascial tissue is equally distributed throughout the entire body, enveloping, interacting with, and permeating blood vessels, nerves, viscera, meninges, bones, and muscles, creating various layers at different depths and forming a tridimensional metabolic and mechanical matrix. The fascia becomes an organ that can affect an individual's health.[8,9]

From an embryological perspective, the fascial system originates in the mesoderm, although according to some authors this connective network can be partially found in the neural crests (ectoderm), with particular reference to the cranial and cervical area.[10]

The fascial system has various tools for communicating inside and outside the body, precisely because of its characteristic feature of enveloping and supporting each body area. These communications allow rapid adaptation of bodily functions, from posture to metabolic function, from vocal expression to psychological and pain perception, affecting the health and well-being of the person.[8-13] We again find the ability to communicate with electrical activity, as we know that the fascial system distributes electrical pulses in conjunction with or independently from the central and peripheral nervous system.[1,10] The fascia communicates with liquid tools, through ducts known as the Bonghan ducts, a network that carries information to all parts of the body, independently of the lymphatic and blood systems.[9,14] Metabolic tools synthesized via

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paracrine and autocrine signaling by the fascia, place the entire body in communication with different molecules capable of influencing tissue, muscular, visceral, bone and neurological behaviour.[9,15-18] The individual cells that make up the fascial system, such as fibroblasts and telocytes are able to physically communicate with neighboring and distant cells, through the bridges temporarily created by such cells to transport flows of organic information.[9,19] The pressure generated by the contraction and elongation of the myofascial system allows the cells to deform and adapt, a phenomenon which is at the basis of mechanotransduction; pressure is another powerful communication tool for the entire organism.[9,10]

There are other means of communication of the fascial system that are studied less, although they are equally important, such as the sound generated by the sliding of the various fascial layers and the light that is rhythmically emitted by the fascia. To the authors' knowledge, this is the first article to examine what is found in the literature on these 2 fascial features, by summarizing and putting some considerations into a single text.

This narrative review has taken into account the scientific texts present in the literature, discussing the nature and the possible meaning of such phenomena in the fascial system. The goal is to try to understand whether the biophotons and adjustable sounds may be useful in the practice of osteopaths, chiropractors and manual therapists, as a new evaluation to use to validate The patient's response after the operator's approach.

Ultraweak Photon Emission

Biological systems continuously emit weak light. This phenomenon has several names, including autoluminescence, feeble luminescence, weak biophoton emission and spontaneous chemiluminescence.[20] The definition currently and commonly used to indicate this phenomenon is ultraweak photon emission (UPE), which is subdivided into spontaneous and induced types.[20] The UPE is a different mechanism compared with luminescence, which is the light reflected from an external source or photoexcitation.[21] Photons are an electromagnetic field quanta, whose nature is to interact between electrical charges like electrons or charges of electrical aggregations like atoms, molecules, and macromolecules.[22] Spontaneous emission occurs without the presence of external stimuli, while the induced one is caused by biotic factors (viruses, bacteria, and fungi), and abiotic factors like the temperature and gas present in the environment, mechanical and light stimuli, ionizing radiation.[20] The spontaneous UPE has an emission intensity that is around 10 and several hundred photons per second per square centimeters, while the induced one may increase by 2 or 3 times more.[20] Therefore it is not visible to the naked eye, with a spectral range of between 350 and 1270 nm.[23,24]

We do not as yet have a cause, recognized as being the only valid one, to explain this emission of light. A model is related to the biological activity of the cells, in particular to cellular respiration or oxidative metabolism and the reaction of free radicals, inferred from experimental studies in vitro. The electric transition of electrically excited species during the oxidative metabolic process, from singlet or triplet excited state to the single ground state, is accompanied by the emission of photons at short- and long-wavelength regions of the spectrum, respectively.[20] The presence of free radicals or reactive oxygen species (ROS), corresponds to the presence of UPE.[24] Usually, the production of ROS plays a key role in defense against infections, apoptosis, aging, and cellular communication.[24] The presence of reactive nitrogen species (RNS) also boosts UPE.[24] According to some authors, the presence of electrical or chemical stimuli such as aerobic metabolism and the production of ROS/RNS, are not a key element for the synthesis of biophotons, but secondary players in UPE response; they act to maintain photon emission.[25] Electrical activity related to excitation of the membrane of the cellular tissues is probably more important in triggering emission, although the mechanisms still remain obscure.[25]

According to another theory, deoxyribonucleic acid (DNA) is the main source of the UPE phenomenon. A consistent electromagnetic field is found in the DNA that becomes the basis from which these photons are emitted.[26] Electrical polarity is found in the majority of biological molecules, consisting of electric dipoles and/or multipoles; this consistent polarity generates vibrations, probably emphasized by the presence of water, consequently generating an electromagnetic field.[27] The chromosome behaves like a laser emitter, like a modeled structure to emit quantum images expressed as photons, which will then be organized into morphogenetic information.[28] We do not currently have any real evidence that endorses DNA as a main source of UPE.

Local and Rhythmical Emission

The phenomenon of photon emission varies according to location in the body and circadian and seasonal rhythms. In summer, the phenomenon of UPE is greater compared with that in winter, when there is a marked reduction, variations that are not related to the change in external temperature.[23,29] Generally, throughout the course of the day, emission is weak during the period of external light, while it rises in the evening, and this fluctuation is neither affected by the change in external or internal temperature (micro circulation) nor by the intensity of sunlight or artificial light.[29,30] There is an inverse relationship with the level of cortisol in the blood, where if the percentages of cortisol are higher UPE is lower, and vice versa.[30]

UPE in the area of the face is not homogeneous, where there is a greater concentration in the area around the mouth and cheeks, compared to the eye sockets and the remaining surface of the face.[30] The palms of the hands emit a quantity of photons that is almost double compared to the back, probably related to the density of the skin; elderly people show a greater intensity of emission from the hands, perhaps due to the increase in the oxidative state of the proteins of the horny layer (stratum corneum) of the skin.[21,23] The abdomen and chest have a lower UPE, compared with the limbs and the region of the head, where higher values are registered.[29] The symmetry of the

2 sides of the body, right and left, is more homogeneous compared with the symmetry of the dorsal and abdominal area of the human body.[29]

We can identify a rhythm, an oscillation that determines a biological logic and implies a physiological function. For this reason, UPE variations may indicate a disease or simply mark a bodily structure's health action.

Ultraweak Photon Emission and State of Health

Various studies have highlighted that state of health influences the emission of photons by the human body. Areas of lesioned skin in the acute or chronic stage demonstrate greater emissions than the same areas when intact, although the reasons for this have not been clarified.[23] In patients with alterations of thyroid function (hypothyroidism) or removal of the endocrine gland, UPE is less; the contrary is recorded in patients suffering from multiple sclerosis, where emission is higher compared to healthy subjects (10-20 times more), and the symmetry of the 2 sides of the body is compromised.[23,29,31] In subjects with hemiparesis the emission values are conflicting, where in some subjects they are within the norm and in others they are altered compared with healthy subjects.[23,32,33]

It is well documented that the intensity of UPE emission increases as the number of tumor cells increases, compared to tissue without any cancer presence.[34] This linear increase of photons probably corresponds to the increase in ROS, where the growth of the radicals is parallel to the growth of the tumour.[20]

The person's mental state is able to alter the emission of biophotons, reducing the phenomenon, albeit with marked subjective differences. A study measured this emission in subjects who practiced meditation (transcendental and OM meditation), demonstrating that a state of relaxation affects UPE, with values that tend to be lower.[29]

Nutritional status may likely affect the UPE phenomenon, where a healthy diet rich in antioxidant foods may lower the detection of biophotons, endorsing the ROS model.[29]

Diaphragm movement (deep breathing) is able to promote an increase in the emission of biophotons in some people, but not all; we do not know why.[23]

At present, there are no studies on large numbers of patients to be able to say with certainty that a local or systemic alteration can influence the emission of photons but, as several authors have highlighted, this could in the future become a diagnostic evaluation tool.[20,34]

According to a recent study of animal model with arthritis, there is a relationship between oxidation (inflammation) and UPE recurrence. This relationship could serve as a new diagnostic tool for assessing rheumatic disease.[35]

UPE measurements could be used to evaluate the biological age of the human being, trying to associate the emission value and real aging as a prevention of more serious pathologies.[36]

The use of UPE measurement in patients could prevent worsening of diabetes by detecting the level of tissue oxidation and thus personalizing the drug therapy.[37-40]

Biophotons and Cellular Communication

Is UPE a cellular communication tool? Cell-to-cell communication on the part of biophotons was demonstrated in plants, in bacteria, in neutrophil granulocytes, in animals, and in renal cells.[41]

Various studies indicate that neural activity is correlated to UPE and that there is a relationship between the theta waves of the electroencephalogram and the intensity of photon emission, in vitro and in vivo animal models.[20] One hypothesis is based on the idea that the collective interaction of electric excitation that occurs on the endogenous cell surface through intrinsic protein structures (alpha-helical integral protein), can form an electron-soliton, that is, a solitary self-reinforcing electric wave; propagation of such an additional wave allows the transfer of energy to the DNA (DNA is a liquid crystal), inducing conformational changes in it that will produce biophotons.[28,42] The biophotons thus produced, are sent along the axonal and neuronal ramifications, between and within the neurons, and throughout the central nervous system.[42] The neurons contain various light-sensitive neurotransmitters (tryptophan, phenylalanine, tyrosine, and other molecules), and it is difficult to imagine that the nervous system is not affected by the phenomenon of UPE and that such conduction of photons does not transport encoded information.[26,43] This conduction mechanism is probably influenced by the orientation of the nerve fiber, and occurs with greater emphasis in the white matter of the brain.[22] The neural ramifications form light conducting optical fibres.[22,26] The fascial system that protects and guides the nervous system plays a prominent role in transporting the photons produced.[22]

The blood system is capable of conveying biophotons. Similarly, the albumin, white blood cells, and free radicals present in the bloodstream, carry the photons in all the ramifications of the vascular tree, with a mechanism called phototransduction.[22,44] The repercussions of this phenomenon are currently unknown.

Manual Treatment and Biophotons

Manual therapy, such as osteopathic and chiropractic treatment, has proven to create variations in photon emissions. Studies have highlighted how approaches with direct articular techniques (high-velocity low-amplitude), or cranial-sacral techniques, influence the emission of photons both locally and in distant areas from the manual application area, with a reduction and an increase, respectively.[33] The UPE response is probably related to the fascial tissue, as well as its regional propagation and throughout the body, as a response to the techniques.[33]

Studies show how other complementary and alternative medicine, such as acupuncture, may vary the emission of UPE, probably thanks to a prominent role of the fascial system.[13,28]

The reasons for these events recorded in vivo and on healthy people is not yet known. We have little data to use biophoton emission in patient evaluation after the manual approach. We

need more studies on patients and with different pathologies to understand the usefulness of measuring UPE as a clinical tool.

Fascial Sounds

The sound that can be recorded from the myofascial tissue was mentioned for the first time in 1665 and only picked up again in 1810, described as a "rolling of distant thunder," with a frequency between 20 and 30 Hz.[45] The sound was heard with a rudimentary stethoscope, while in modern times much finer equipment is used with a microphone placed on the skin.[45,46]

In the modern scientific landscape, there is a lack of agreement on the origin of this acoustic phenomenon but, rather, a convergence on the clinical significance and function of the myofascial system. The sound recordable from the tissue may be used as a clinical evaluation of muscular strength, coordination, and appropriate intervention of motor units.[45,47-49]

The acoustic myogram records the sound produced during active movement of a muscular district, in parallel mode with regard to the recordable signal from the electromyogram.[50]

One of the assumptions on which this phenomenon is based is the lateral vibration of the muscle fibers during active contraction or with external stimulation by electrostimulation, a vibration that produces pressure waves that generate a sound.[45,51,52] The lateral vibrations are caused by differences in pressure along the muscle fibre.[52] This propagation of pressure occurs in a precise and oscillatory pattern, and for this reason can be used as a diagnostic tool in healthy individuals with conditions, both in adults and in paediatrics.[52]

The sound may derive from the vibration of the muscular fiber on the passage of the electric current, and corresponds to the resonance frequency proper to the fiber.[53,54] This vibration could reflect on the connective tissue rich in crystalline structures, producing an oscillating electric field of the same frequency of recordable sounds due to piezoelectric effect.[13]

At present there are no studies that determine or measure an effect on the recordable sound from the myofascial system, by applying a manual approach.

We know that the myofibroblasts are able to produce rhythmic contractions, mechanical oscillations that affect the fascial environment, metabolically and functionally.[9,10] These cells exhibit a cyclical contraction in parallel to the oscillations of the presence of intracellular calcium, with a peak of 99 seconds for each contractile cycle, and more static (isometric) contractions due to the presence of the Rho and Rho-associated kinase (ROCK) substrate.[55] We do not know if the recordable sound could also arise from such fascial behavior.

Lights, Sounds, and Manual Therapy

From the literature it emerges that the biophotons and sound from the fascial system possess a rhythm, an oscillatory transmission pattern; they have a language that, very probably, transmits information.

Recent models to understand how cellular interaction occurs, demonstrate how the vibrational/oscillatory frequencies allow transfer of electrons between 2 cells, thus allowing receptor activation and protein binding.[56] In vitro experiments with embryonic stage mouse fibroblast cells, demonstrate that the presence of vibrations is able to determine the shape of the cell and its functional capability, by acting directly on the DNA.[57] Another study evaluated the effect of vibration on the differentiation and proliferation of human periodontal ligament stem cells, highlighting the possibility of guiding their behavior and final destiny in ageing.[58]

The approach of the therapist's hand using manual techniques on the body system and on the fascia, determines a change in the pressures between the cells and in the cell itself, probably by acting on the variable pressure of the fluids such as hyaluronic acid.[59] Mathematical models shed light on how perpendicular vibrations or tangential manual oscillations may alter the cell pressure through displacement of the hyaluronic acid.[60] Another in vitro study with human fibroblasts, stimulating them with repetitive pressure to reproduce manual fascial techniques, showed how the treatment is able to change the shape and vector direction of the fibroblasts.[61] Another in vitro study, with different pressure forces with human fibroblasts, reported that the cells are able to respond at metabolic level to external information, as in manual techniques.[62] Various instruments are also used in manual therapy for treating patients, which allow deeper vibratory stimulation to be given to the person; however, we do not have any studies that determine cell adaptation to such therapeutic means, although some texts do report clinical benefits.[63,64]

At present, there are some manual approaches that allow vibratory stimulation to be given to the tissue, but we have not yet established the most appropriate intensity to create pressure conditions such as to produce a biophoton or sound response corresponding to the creation of a healthy physiological environment. We know that evaluation of such phenomena is feasible to understand the clinical state of the patient, in a noninvasive way that is not annoying for the person, but the research carried out does not include large numbers of subjects, and there are no researches on different pathological conditions.[64] Research must make a greater effort to identify the vibrator and oscillator values that could be used by manual therapists, stimulating tissues toward a framework of health. At the present state of research, we cannot affirm the usefulness of measuring the adjustable sounds from the fascia.

Conclusions

The emission of biophotons and the production of sounds from the fascial system has a clinical significance, even though we do not know exactly the reasons that underlie these physical phenomena. Vibrator and oscillator patterns are present when UPE and sound are recorded. Some manual techniques involve the use of vibrations and oscillations, that are perpendicular or tangential to the tissue. We do not currently have any data that enables us to understand at what values to manually impose vibrations, nor what happens as a tissue response to these stressors. We cannot affirm the

usefulness of measuring the UPE and adjustable sounds from the fascia as a clinical tool.

Research must make further efforts to create a union between the manual treatment approach and the use of these physical phenomena, with the ultimate aim of improving the patient's health.

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Ethical Approval

As this is a review article, and there is no need for ethical approval.

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