

**Effects and Clinical Application
Of Electric Field Therapy Apparatus**

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1. Outline of the Electric Field Therapy Apparatus

1.1 The Electric Field Therapy Apparatus as a Physiotherapy Apparatus

The electric field therapy apparatus is a kind of physiotherapy apparatus. Physiotherapy leverages lubrication of the natural healing power of the body. In effect, it stimulates the reaction of the body towards maintaining its balance (homeostasis), by providing the body with physical energy to help its various self-feedback systems (e.g. autonomic nervous and endocrinal systems) operate smoothly.

The electric field therapy apparatus is different from any other physiotherapy apparatuses in such that the other devices provide physical energy such as heat, light, electricity and/or magnetism to body parts (e.g. shoulders, knees and/or elbows) in order to improve blood circulation or ease facing pains. The electric field therapy apparatus delivers only a very small amount of electrical energy sufficient to activate the natural healing systems.

1.2 Electric Field Therapy Apparatus Enhances the Power of Natural Healing

The advances of research and development with regard to electric field therapy apparatuses in Japan has introduced to clinical applications that have been carried out for more than 50 years. Today, many types designed for household use are widely available in addition to apparatuses for professional use in medical institutions.

A human body consists of approximately 6 billion cells that carry out a wide range of functions. The general function of the body activates a feedback mechanism that helps to maintain an optimum environment for these cells to perform their vital activities. In other words, when the external environment changes, the body functions to optimize its internal environment; including the osmotic pressure of body fluids, the gaseous composition and electrolyte composition of the blood, pH and body temperature. To maintain its internal environment constant, the cells and organs of our body are controlled by a self-feedback mechanism that is based upon cooperation among the nervous, endocrinal and immune systems.

This constancy that is maintained within the internal environment of our bodies is called “homeostasis” and, in effect, is maintained by the cooperation among our systems and the regulating mechanism of our individual organs.

“All vital mechanisms, regardless of varied they may be, have only one objective; that objective consists solely of the preservation of the conditions of life within the internal environment of our bodies.” (19th-century French physiologist Claude Bernard)

We need to maintain homeostasis if we are to continue to live. We get sick when our homeostasis is significantly disturbed, but we also have an automatic mechanism that works to maintain homeostasis (the feedback mechanism). This is called the “homeostasis mechanism” or “natural healing power”.

The body can recover from illnesses if the degree of the homeostasis disturbance is within the limits of our natural healing power. If it exceeds these limits, the result is death. Natural healing power, in other words, is the power to prevent us from illness or to help us recover from illness.

A therapy using an electric field therapy apparatus works to enhance the

natural healing power that maintains homeostasis within our bodies.

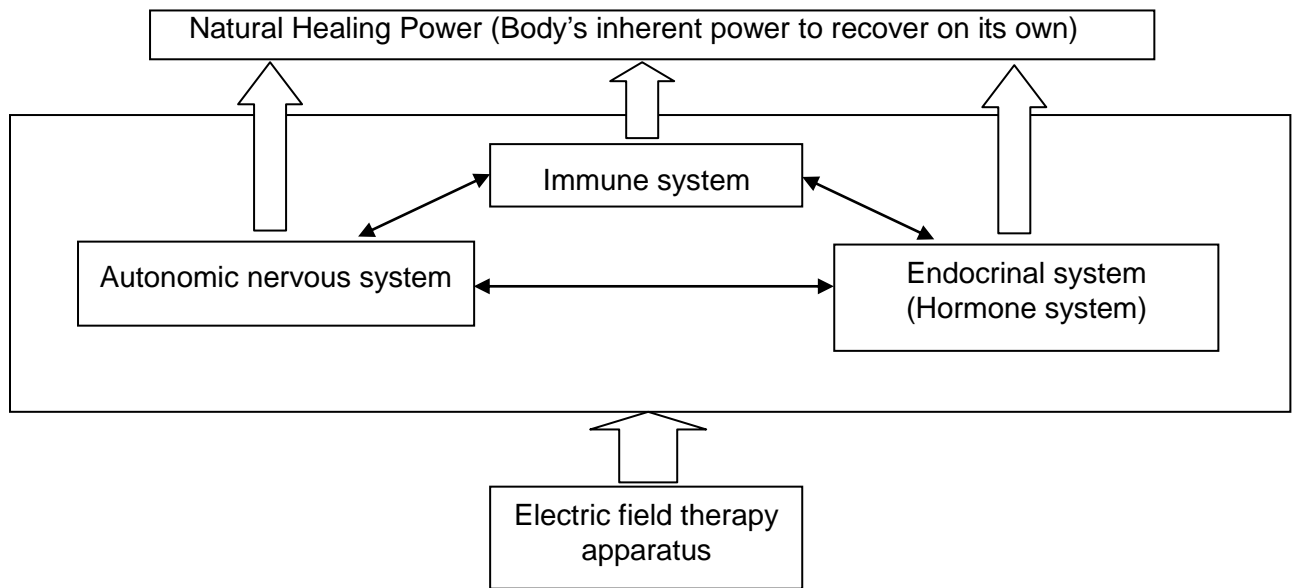


Figure 1.3-1 The function of an electric field therapy apparatus

1.3 Examples of the Electric Field Therapy Apparatus' Effects in Maintaining Homeostasis

According to the test, the changes in the maximum blood pressure of mature male and female rats subjected to daily 15-minute treatments with an electric field therapy apparatus (output voltage of 7,000V) over a 5-day period were seen. Rats with high blood pressure showed a decrease to normal pressure, and rats with normal pressure did not show any changes.

Unlike medication that has a single effect, electric field therapy apparatus treatments have the capacity to restore abnormal conditions to normal, and to maintain normal conditions, just as they serve to maintain homeostasis.

2. The Principles of the Electric Field Therapy Apparatus

2.1 Principles of Electric Circuitry

An electric field therapy apparatus applies a high voltage (for instance, 9,000V) to the body (but no electric current is applied) to generate a potential difference between the body and a wall or the floor of the room (normally 0V) and to produce electric fields (space in which electric forces work) around the body. An electric field therapy apparatus is a physiotherapy apparatus that utilizes the actions that the electric fields have on the body.

2.2 Electro-physical Principles

2.2.1 Distribution of an electric field in space

An electric field therapy apparatus is a physiotherapy apparatus that utilizes the actions of the electric fields that surround the body. In case 10,000V is applied through an accessory mat, it was simulated with a computer analysis. It showed higher kV/m² at head, hip, knees and foot while the floor, ceiling and walls were kept at 0V.

2.2.2 Distribution of electric field strength on the body surface

For a computer analysis of the distribution of electric field strength on the body's surface, 10,000 V of electricity are applied through an accessory plate. An intense concentration of electric fields can be seen on the head and in the fingers.

2.2.3 Internal inductive current

When an electric field is generated around the body, a very small amount of electric current (microampere: one one-millionth of an ampere) is generated inside the body. This is called an internal inductive current. Its level varies from 1(head) to 23(calf ankle) mA/ m².

3. The Mechanism of the Electric Field Therapy Apparatus' Effects

3.1 Electricity's Biophysical Interactions

Biophysical interactions derived from the effects that electricity (or electric fields, in a broad sense) has on the body can be divided into the following three:

1. Stimulative effects of electric current
2. Heat generation
3. Other effects

The stimulative effects of electric current (1) are sensory reactions to stimuli caused by electric current running through the body. The types of stimuli depend on the length of time the current flows. Electric current stimuli also depend on the frequency, creating larger stimulation at low frequencies and smaller stimulation at high frequencies. A typical physiotherapy apparatus is the low frequency therapy apparatus which applies an electric current of special wave form of a few to several thousand Hz to a living body, creating effects similar to a slight nervous paralysis or a massaging effect.

Heat generation (2) is caused by the electromagnetic energy absorbed by the body. A physiotherapy apparatus typical of this type would be an ultra short wavelength therapy apparatus that passes high frequency current from an electrode to generate heat inside the body. This produces warming effects such as improvements in the circulation of blood.

One of the other effects (3) includes what is called "non-thermal effects". These are considered to be unique to phenomena other than heat. An example would be the effect on the body by electric fields of extremely low frequencies (ELF) of 50 –60 Hz. Shenpix Electric Field Therapy Apparatus is a physiotherapy apparatus that employs this non-thermal effect.

ELF electric fields' effects on the body (non-thermal effects) are as follows:

1. Stimulative effects on sensory receptors by the electric fields that act on the body surface.
2. Effects on cells created by electric currents induced to the body by electric fields on the body surface.

3.2 The Mechanism of the Electric Field Therapy Apparatus' Effects

3.2.1 Effects of sensory receptors on the body surface

(1) Stimuli by body hair movement

Hairs on body surface can be expressed with an electric constant. A cylindrical inducer (hair) is standing at an angle on a flat conductor (skin). When an electric field is applied to a body surface in this manner, dielectric strength is applied to the body hair causing the hair to rise.

When an electric field is generated on a cat's hind leg, for example, the electric force (dielectric strength) of the field makes the body hair move, and action potential is generated in the nerve fibers that stimulate the sensory receptors of the body hair. Receiving a signal of such an action potential, the brain recognizes the electric fields surrounding the leg.

Sensory information is first sent to basal ganglia in the thalamus of the interbrain. The thalamus has nerve fibers that transmit information to the hypothalamus. The stimulus transmitted to the body surface by electric fields has an effect on the brain's hypothalamus, which is the center of the autonomic nervous system and the endocrinal system.

The stimuli made by the movement of body hair to the skin of the whole body are similar to the principles of acupuncture and moxibustion of the Chinese medicine. It can be explained that stimulating acupuncture points that are all over the skin surface causes particular organs to react, which is called the reflexes of internal organ parieties.

(2) Effects on the autonomic nervous and endocrinal systems

The time-series change in the amount of corticosterone (glucocorticoid) in mature rats' serums after a 15-minute exposure to an electric field therapy apparatus (7,000 V) was visible with a test.

After the exposure to the apparatus, corticosterone continued to decrease for several hours after treatment. After 24 hours, its level returned to nearly the original amount. This means that the apparatus has a mild endocrinal effect through the pituitary gland and adrenal cortex systems, which suggests the existence of a stress-relieving effect on the central nervous system.

It was also shown that the exposure tot the apparatus significantly lowered adrenocortical hormone (ACTH). On the other hand, no change was seen in catecholamine (noradrenalin, adrenaline and dopamine).

The effects on the autonomic nervous and endocrinal systems activate the natural healing power to maintain homeostasis to ease unpleasant symptoms of various kinds.

3.2.2 Effects of electric current induced into the body

There are 3 types of effects that are caused by the induction of a very small amount of electric current into the body:

1. Changes in physicochemical behaviors (e.g. ionizing) of body fluids (intracellular and extracellular fluids)

2. Changes in the permeability of cell membranes
3. Effects on the electron-transmitting system of intracellular mitochondria, affecting ATP production

Changes in body fluids (1) can be seen as the skin (especially the inner skin) impedance changes due to the effects of the electric current running through electrolytes (body fluids), such as ionizing.

Changes in the permeability of cell membranes (2) are caused by a small amount of electric current (microampere: one one-millionth of an ampere) that is induced into the body and runs through the membrane-dependent calcium channel (VOC) and depolarizes enough cell membrane for absorbing calcium ions. The increased intracellular calcium ions then play a fundamental role of affecting the cell wall and ion movement, including the increase of ATP production in the mitochondria.

The microampere-level electric current activates the electron-transmitting system of intracellular mitochondria (3) and enhances the synthesizing of ATP. This enhances metabolism, facilitates the restoration and regenerates cells, and adjusts, recovers and improves the muscular tone. The current also restores and expands blood vessels, improving the circulation and lymph fluid flow as it ease pain.

Electric current induced into body has effects on body fluids and cells, enhancing the metabolism of the cells and tissues and easing stiffness and pains. It is also effective as a treatment for stiffness in the shoulders, backache, knee pain, etc. Some test results show that it also promotes the healing of fractured bones.