Volume 7 Number 6 December 2001 ISSN 1075-5535

The Journal of

Alternative and Complementary Medicine

Research on Paradigm, Practice, and Policy

Kim A. Jobst, DM, MRCP
Editor-in-Chief

Jackie Wootton, MEd
Executive Editor

Listed in all major indexing services including:
Index Medicus/MEDLINE • Current Contents/Clinical Medicine • EMBASE/Excerpta Medica

Mary Ann Liebert, Inc. publishers

www.liebertpub.com

THE JOURNAL OF ALTERNATIVE AND COMPLEMENTARY MEDICINE
Volume 7, Number 6, 2001, pp. 617–627
Mary Ann Liebert, Inc.

Quantitative Analysis of Reproducible Changes in High-Voltage Electrophotography

MARK RUSSO, B.S.E.,[1] ASIM F. CHOUDHRI, B.S.,[1] GERARD WHITWORTH, R.N., C.C.P.,[2] ALAN D. WEINBERG, M.S.,[1] WILLIAM BICKEL, Ph.D.,[3] and MEHMET C. OZ, M.D.[1]

ABSTRACT

Objectives: The existence of electromagnetic fields not generated by neuronal action or muscle stimulation remains controversial especially because they are difficulty to detect. We attempted to investigate the existence of electromagnetic fields associated with biologic systems using new image analysis techniques to analyze high-voltage electrophotography.

Design/Subjects: Five energy practitioners (three males and two females) and five control subjects (four males and one female) participated in the study. Each practitioner had studied a formal training curriculum and was a professional energy practitioner.

Images representing attempts of both energy practitioners and controls to elicit a change in electromagnetic emissions were captured by electrophotographic means. A statistical analysis on the comparison of "ON" vs. "OFF" states for the controls and practitioners in the study was made via digital representation of analogue images.

Results: Our interest was threefold: (1) to determine whether corona discharge patterns could be obtained and photographed and be reproducible; (2) to quantify some of the qualitative properties of the coronas; and (3) to determine if individuals can alter, at will, their electrophotographic images. We found a correlation between a change in the electromagnetic emissions for the body and the conscious desire of an energy practitioner to change this state. Analyses of individual finger coronas demonstrate statistically significant differences as analyzed by overall color changes and via analysis of individual sections of the various colors dominating the field. Control subjects were unable to produce statistically significant changes that were reproducible. Physiologic processes, such as changes in skin resistance, sweating, and surface blood constriction, have been suggested as an explanation of the colors and patterns that appear on the film in previous studies, but were not observed in this investigation.

Conclusions: After controlling for the above variables and identifying reproducible and statistically significant changes, we believe the images created in our study represent the interaction of biologically generated electromagnetic fields interacting with the corona discharge created by the electrophotographic device.

[1]Department of Surgery, Columbia University College of Physicians & Surgeons and Columbia-Presbyterian Medical Center, New York, NY.
[2]Department of Complementary Medicine Services, New York Presbyterian Hospital, New York, NY.
[3]Department of Physics, the University of Arizona, Tucson, AZ.

INTRODUCTION

The existence of electromagnetic fields not generated by neuronal action or muscle stimulation remains controversial especially because they are difficult to detect. We have attempted to investigate the existence of electromagnetic fields associated with biologic systems using newly available image analysis techniques to analyze high-voltage electrophotography. Pictures were created by capturing the light emitted from corona discharges generated from the interaction of a time-varying high-voltage electric field and the subjects. Numerous investigators including Nicola Telsa (Peheck et al., 1976) have reported similar corona discharges of unclear significance. However, the Russian researchers Semyon and Valentina Kirlian (Kirlian and Kirlian, 1961) have dominated this field since their initial report in 1939, although the Western public did not know their work until 1970 (Ostrander and Schroeder, 1970).

This type of photography has been posited to be a potentially valuable medical diagnostic tool and the Kirlians have reported subjects who had modified or disrupted patterns of discharge before obvious symptoms of illness became manifest. Because of the myriad physiologic and experimental variables affecting the discharge pattern of a Kirlian image, standard images are extremely difficult to achieve and have limited potential benefit.

If an electromagnetic field that might be associated with biologic systems can be altered by conscious or physiologic means, then a change in images corresponding to particular electromagnetic emissions might be detectable. To this end, we performed a randomized prospectively controlled study using untrained controls and self-proclaimed energy practitioners, which we are defining for this paper as individuals who believe they have the ability to alter the energy fields within and around their bodies. Physiologic manipulations including biofeedback, alterations in fingertip pressure on the film, ischemia, temperature change, hyperventilation, and hypoventilation were included to assess the variability of the corona images and seek an underlying organic explanation for observed changes. Of note, we did not explore electrophotography as a diagnostic tool nor did we seek a parapsychologic interpretation of the resulting image.

METHODS

Five energy practitioners (three males and two females) and five control subjects (four males and one female) participated in the study. Each practitioner had studied under a formal training curriculum and acted as an energy practitioner on a professional basis.

The technique used by the energy practitioners differed based on their method of training, which consisted of:

- Integrative Energy Medicine, defined as modulation and directing of vital energy (*qi*)
- Integrative Energy Medicine is a combination of Therapeutic Touch, European Standard ITTA (International Therapeutic Touch Association), and Energy Therapies taught by Rosalyn L. Bruyere
- Chinese Energy Medicine (*Yuan Ji*).

Control subjects were selected from personnel working at the university, including several medical students and medical center volunteers. Sample size was determined by availability of practitioners and controls.

Images were created using the electrophotographic device depicted in Figure 1. The experimental apparatus is illustrated in Figure 2.

Two gates of a 4049 hex inverter are configured as an adjustable oscillator the frequency range of which is approximately 250 to 10,000 Hz. The output of the oscillator section triggers a TIP 120 NPN Darlington transitor, which in turn triggers a high powered metal-oxide semiconductor field-effect transistor (MOSFET). A 200-volt Zener diode protects the MOSFET from reactive surges by providing a clean path to ground. The gate of the MOSFET is connected to one terminal of a high-voltage autotransformer. The other terminal is connected to the 14-V power supply. A 130-volt metal oxide varistor was placed between the two terminals of the transformer for additional protection from surges that in the past have damaged the Zener and ultimately damaged the MOSFET.

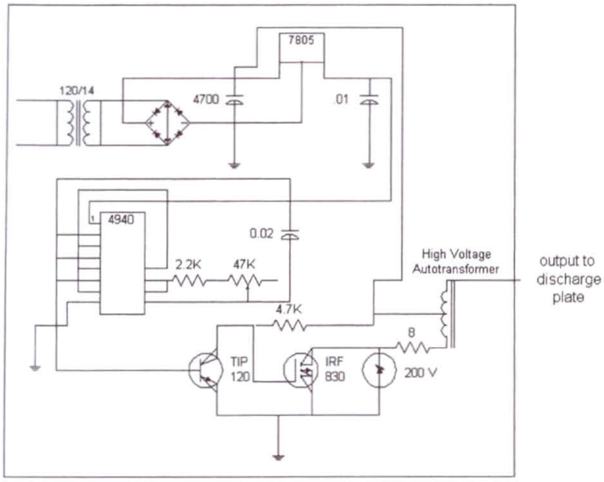


FIG. 1. Schematic of the frequency generator and high voltage power source for the electrophotographic device.

The waveform generated by the oscillator is a unipolar square wave with peak amplitude of approximately 20 kV after being amplified by the autotransformer. The output of the autotransformer was fed into the 5 × 8 inch discharge plate. Because neither the spectrum of the electromagnetic field (EMF) generated from a biologic system nor the interaction within the body of an externally produced EMF is defined, the sensitivity and broadband characteristics of this device make it suitable.

All subjects washed their hands with surgical scrub and maintained coverage to provide a sterile environment prior to measurements, which were performed immediately. Fingernails were trimmed to eliminate interference with image creation by allowing uniform contact with film. A platform was constructed of wood to restrict movement of the subject's hand so that only the tip of the middle finger was able to make contact with the film on the discharge plate at a 90 degree angle between the film and the finger. A constant force was maintained on the film plane by the finger and was used for all measurements. A Sartorius GM6101 (Goettingen, Germany) 6100-gram balance was placed under the discharge plate to monitor the force applied to the film. Subjects agreed to push with a force of 40 gs, which was monitored continuously during the measurements to remain with ±5 gs. The distance from the platform and the discharge plate was positioned so that by instructing the subject to apply a moderate force the pressure on the plate was limited to 40 gs. If the subject moved their finger, the force applied to the film plane would change and be recorded by the balance thus nullifying the measurement.

The tip of the middle finger, which has the end of the pericardium meridian (Pe9) of the left or right hand depending on preference, was applied approximately perpendicular to the apparatus for all measurements. Kirlian images seem to reveal activity on the acupuncture meridians. Selection of the middle finger was based on conversations with the practitioners stating that the intensity of the energy emitted from the middle finger is greater then the other digits in the hand. Because no evidence exists either to refute or support their claims of en-

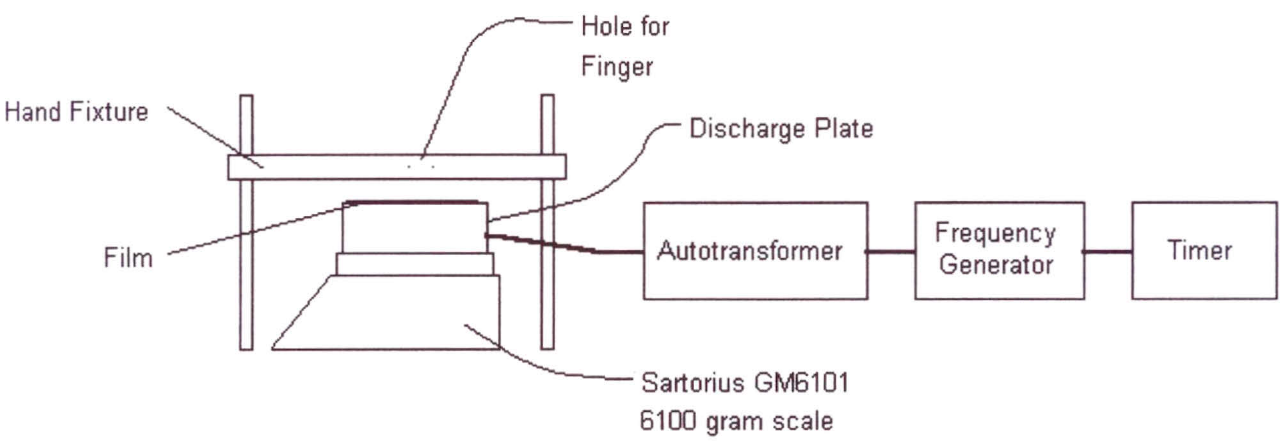


FIG. 2. Experimental setup indicating the components of the electrophotographic device (exposure timer, frequency generator, power source, and discharge plate), scale, and fixture to limit movement of the subject's hand during exposure.

ergy emissions from particular digits, it was agreed to allow measurements of the middle finger. Exposure time was set to 10 seconds based on preliminary measurements demonstrating sufficient time to render an image capable of containing the desired information without oversaturation of the film, which causes blurring of the discharge pattern. The frequency of the electrophotographic device was varied until the corona discharge was optimized to a maximum discharge, 7 kHz ± 350 Hz. Voltage and frequency of the device remained constant for all measurements thereafter.

All measurements were made using Kodak Ektachrome 100 Professional 4 × 5-sheet transparency (Kodak, Rochester, NY) film that was refrigerated at 4°C until 2 hours prior to use at which time it was allowed to warm to room temperature. Film was placed on the electrophotographic device with the emulsion side of the film facing the discharge plate. The theoretical cross section of ektachrome film consists of: static-resistant backing; nonconductive base; antihalation layer, colloidal silver; blue + red sensitive + colorless cyan dye-forming coupler* (d.f.c.); blue + green sensitive + colorless magenta d.f.c.; colloidal silver layer (yellow filter); and blue-sensitive plus colorless yellow d.f.c.

The structural layer of the film that was in contact with the subject's fingers consisted of the static resistant backing, a nonconductive base material, and an antihalation layer containing colloidal silver. Film emulsion was the same for each day's measurements. Ambient temperature and humidity were measured but not controlled. Humidity and temperature has been shown by Ebrahim and WIlliams (1982) to have minimal effect of the image process. Measurements were made in total darkness. Each sheet of film was notched on the top edge of the film to enable identification after development. All film was processed at the end of each day at a Kodak qualified Q-lab where control data is collected every 2 hours to ensure consistency in processing chemistry and development times.

*The dye coupler is a chemical that produces a dye by combining with the oxidized products that occur during developing.

Twelve (12) images were collected per subject each session. These images consisted of six pairs of 10-second exposures alternating the focus of energy between "OFF" and "ON." Successive measurements were taken within 1 minute of one another based on conversations with the subjects indicating this was sufficient time to alternate between an "off" and "on" state. Once again because no evidence exists either to refute or support their claims, it was agreed to allow this 1-minute time between measurements, maintaining absolute darkness in the room at all times. Subjects were instructed to turn "on" and "off" their energy in a random order determined using a random number generator with different sequences used in each experiment.

Additional images were acquired on the energy practitioners and half the controls to document the effects of hyperventilation, temperature, and arm ischemia. Subjects were asked to induce a state of hyperventilation by fast and deep inhalation at which point images were created. Temperature effects were evaluated by collecting 10-second exposures after the subject's preferred hand was placed on a 44°C heating pad for 2 minutes and then placed immediately on the film for image creation. Distal ischemia was induced using a blood pressure cuff placed around the dominant upper arm of the subject, with one 10-second exposure captured with the cuff in position but deflated and another acquired after 1 minute of cuff inflation.

Skin surface temperature measurements were made using a Fluke 80T-IR noncontact infrared temperature probe (Fluke Corporation,

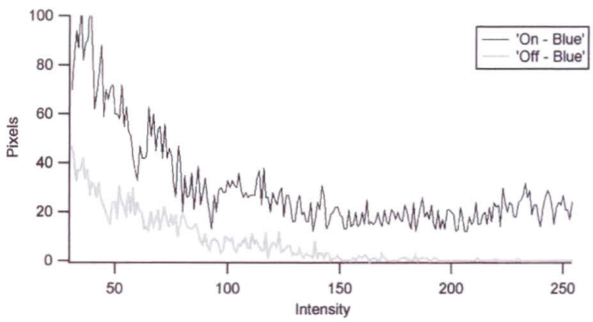


FIG. 3. This graph displays the raw histogram data for the color blue in "ON" and "OFF" measurements of a practitioner. Shown in black and white.

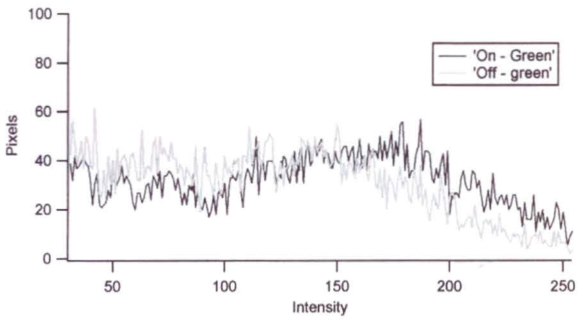


FIG. 4. This graph displays the raw histogram data for the color green in "ON" and "OFF" measurements of a practitioner. Shown in black and white.

Everett, WA). Temperature readings were acquired and saved with a 12-bit analog-to-digital conversion board (Maclab 8e; AD-Instruments, Mountain View, CA) using Chart v3.6.5 (AD-Instruments) software. Temperature measurements were obtained on subjects in alternating "off" and "on" states during image acquisition. Skin resistance measurements were taken for all subjects for both energy "off" and "on" states.

The developed Kodak Ektachrome 100 sheets of film containing the images were scanned using a Hewlett-Packard ScanJet 4c (Hewlett-Packard Company, Palo Alto, CA) at 2400 × 2400 pixel resolution. The scanner was connected to a Dell (Ft. Worth, TX) personal computer (Pentium II/333) equipped with an Adaptec 1505/1515 PCI SCSI card (Adaptec Inc., Milpitas, CA). Scanned images were saved in a TIFF image format as 24-bit RGB images (8 bits per 256 intensities for each red, green, and blue), without the use of an image compression algorithm.

Images were loaded into the Igor data analysis environment (Igor Pro v3.14; WaveMetrics Inc, Lake Oswego, OR) TIFF image files. A histogram, which is a graphic representation of the frequency distribution of intensities of a particular color, were computed for each color layer (red, green, and blue) and exported to Microsoft Excel 97 (Microsoft Corporation, Redmond, WA) and SAS v6.10 (SAS Institute, Cary, NC).

Histogram data for "ON" and "OFF" images for a particular practitioner are displayed in Figures 3 through 5 for individual colors (blue, green, and red). This procedure was followed for all images in the study where it was determined through statistical analysis that significant change indicating a pattern was only observed for the color blue. The mean of each series of histogram data was imported into InStat v3.0 (GraphPad Software, San Diego, CA) for statistical analysis. The first 30 darkest (0–29) and the very last (255) intensity levels were excluded, as they correlated with the black background for the images.

We averaged the absolute differences in scores for the nonenergy practitioners versus energy practitioners over six repetitions and used a Mann-Whitney unpaired nonparametric test to discern the difference between the two groups. Absolute differences negates the effects of the sign of differences since some of the practitioners produced a trend in change where the "OFF" state consistently contained more blue than the "ON" state.

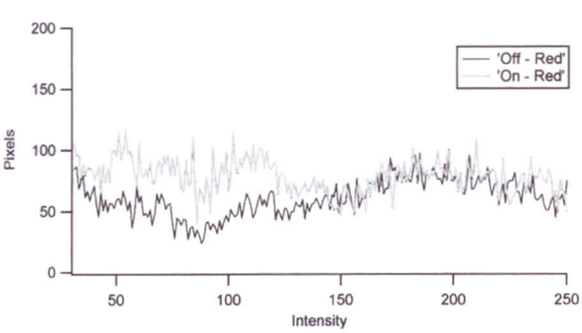


FIG. 5. This graph displays the raw histogram data for the color red in "ON" and "OFF" measurements of a practitioner. Shown in black and white.

RESULTS

Figures 6 through 9 are typical images representing attempts of both energy practitioners and controls to elicit a change in electromagnetic emissions captured by electrophotography. In each image the dorsal side of the finger is at the top on the images. Comparison of "ON" versus "OFF" states for the controls and practitioners in the study are shown in Tables 1 and 2. The two-tailed p value is 0.0952. Table 1 displays the statistical data for the comparison of "ON" and "OFF" states for the practitioners and controls. Table 2 displays the averaged histogram data for the color blue for each image taken for the practitioners and controls.

Two distinguishing characteristics that are repeatable and common among most of the energy practitioners and absent in the control images as displayed in Figures 10 and 11 are a disruption on the corona discharge pattern and the introduction of a blue-violet color. This consistently occurs at a location on the image that corresponds to the base of the finger opposite the fingernail and has been observed in association with a consciously induced alteration in the electromagnetic emissions. A disruption in the corona discharge is typically accompanied with a modification of blue-violet color that appears in the images. Of the 60 images taken of practitioners, 55 demonstrated a disruption of the corona discharge pattern. Within these images, 36 of 36 energy "ON" images displayed the corona pattern disruption. Color differences were determined by analyzing histogram data of the images. Energy "ON" states differed from "OFF" states in every case as displayed in Figure 12. Of note, two of the energy practitioners uniformly had a pattern disruption and associated color shift more pronounced in the nonenergy than in the energy states; however, the trend in change is consistent 100% of the time. Of the 60 images taken of controls, 7 demonstrated a disruption of the corona discharge pattern. Color was observed in 10 of 60 images, but the introduction of color was not associated with a particular state, nor was it concentrated around the disruption of the corona discharge. Only control 4 had statistically significant changes between "ON" and "OFF" states when evaluating the color changes, although a similar difference was observed when assessing the corona discharge disruption. On further questioning, this control admitted to practicing meditation.

Results of additional experimentation searching for an explanation for electromagnetic variation yielded inconclusive findings. Hyperventilation and pressure applied to the film did not demonstrate any significant changes in coronal discharge patterns. No difference was seen using a patient trained in biofeedback techniques between the "bio" state and the resting state, where skin-surface temperature and other physiologic changes were documented and have been well described elsewhere (Ebrahim and Williams, 1982; Wakins and Bickel, 1986). One minute of arm ischemia, induced by inflation of a blood-pressure cuff, did not demonstrate a change in the coronal discharge pattern.

DISCUSSION

The potential of the electric field used to create a Kirlian image is typically between 10 kV to 30 kV. This electric field causes negatively charged free electrons to be ejected from the subject and accelerated towards the positively charged discharge plate of the electrophotographic device. The greater the potential between the discharge plate and the subject, the greater the force of attraction and the greater the acceleration of the electrons. As the electrons travel toward the discharge plate they collide with nitrogen molecules, which constitute 78% of the air, and excite electrons to higher valence shells. Ultimately the electrons fall back to their ground state emitting a photon of a specific quanta of energy. Each quanta of energy is associated with a particular frequency as dictated by Planck's equation $E = h\nu$, where E is energy, h is Planck's constant, and ν is the frquency of the resulting light. If a sheet of film is placed between the discharge plate and the subject, the light from the corona discharge will create an image.

When creating an electrophotographic image the blue-violet spectrum of nitrogen is the only color visible to the naked eye during the exposure process; however, red and yellow colors are dominant on the photographic images. Color is created in a photographic process by the release of one of three dyes corresponding to the primary colors (red, yellow, and blue) previously bound to silver halide. The bond between the silver halide and the dye is sensitive to the specific frequency corresponding to that color in the visible spectrum. When the film is processed, the silver halide that was bound to the dye is removed rendering the dye visible. Spectral emission other than the visible frequency corresponding to that color are able to break the silver halide dye bond for a particu-

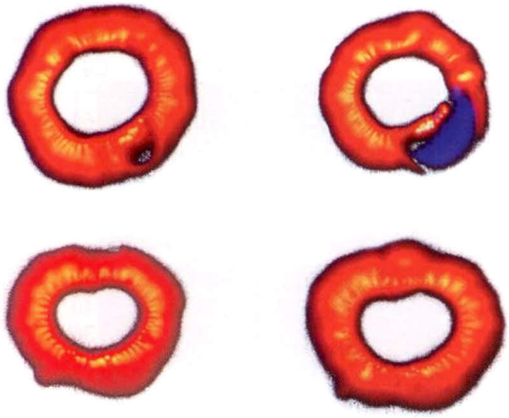


FIG. 6. (Upper left) Energy "OFF" image of a practitioner. Note the slight disturbance of the corona discharge pattern in the lower right quadrant of the image.
FIG. 7. (Upper right) Energy "ON" image of the same practitioner depicted in figure 3. Note the pronounced disturbance of the corona discharge pattern in the lower right quadrant of the image and the introduction of the blue-violet color.
FIG. 8. (Lower left) Energy "OFF" image of a control. Note the absence of corona discharge pattern disruption.
FIG. 9. (Lower right) Energy "ON" image of the same control depicted in figure 4. Note the absence of any corona discharge pattern disruption or introduction of color.

lar color and may be present during this process. Film is designed so that exposure of a particular color will prevent any other colors from becoming sensitized and is constructed so that specific colors are arranged in different layers within the emulsion (Eastman Kodak Company, 1990). Colors rendered within an image are dependent on the frequency of the energy and time at which the energy arrives at a particular location on the film first. Exposing the film with the emulsion side down will change the color of the image created, shifting the rendered color toward red. The added dielectric will act as a filter shifting the frequency of the light incident upon the emulsion. Kodak Technical support (P. Vimislik, personal communication, October 1998) has confirmed that the structural layer acting as a filter could render other frequencies visible that would otherwise be undetectable, specifically within the region of the ultraviolet. We have noted in prior experiments that creating the images with the emulsion down made the film less susceptible to changes in the junction between the subject and the emulsion layer. Further investigations revealed blue as the only change observed other than corona discharge pattern alterations. An important intrinsic property of the film is the ability of a particular dye, once exposed, to inhibit exposure of any other color in that region. The blue dye layer is adjacent to the structural layer so if the entire spectrum of energy were incident on the film at the same time, exposing the blue layer first will inhibit exposing any other color. Considering the frequency shift of the structural layer, the blue-violet in the photograph is actually representative of shorter wavelength energy and suggests energy transmission in the ultraviolet region.

Without the electrophotographic device and inversion of the film, this information would not have been detected. The net gain of the electrophotographic device has not been evaluated and the resultant energy exposing the film is likely to be extremely low. Further measurements of UV emissions from biologic systems are required.

A review of the corona discharge pattern reveals that practitioners interact with the electron flow during the energy "ON" state with some also causing disruption during the "OFF" state. Controls did not disrupt the coronas at all. If the electron disruption is caused by a magnetic component of the emissions, we may be observing electromagnetic emissions from a biologic system with both low- and high-frequency components that can interact with the electrophotographic device. Electromagnetic waves always have both a magnetic and electric field component associated with them. The lower in the frequency the EMF, the more pronounced the magnetic component, the higher

TABLE 1. MANN-WHITNEY COMPARISON TESTS RESULTS OBTAINED USING GRAPHPAD INSTAT VERSION 3.0

Parameter	*P*	*C*
Mean	2227.7	1110.5
# of points	5	5
Std deviation	2086.5	2100.0
Std error	933.09	939.15
Minimum	373.00	18.833
Maximum	5777.3	4862.5
Median	1569.8	181.33
Lower 95% CI	−362.60	−1496.6
Upper 95% CI	4817.9	3717.5

P, practitioner; C, control; CI, confidence interval.
The two-tailed p value is 0.0952 (The p value is exact).
Mann-Whitney U statistic = 4.000, U′ = 21.000
Sum of ranks in P = 36.000. Sum of ranks in C = 19.000.

TABLE 2. AVERAGED HISTOGRAM DATA FOR THE COLOR BLUE APPEARING IN IMAGES FROM PRACTITIONERS AND CONTROLS

	P1	*P2*	*P3*	*P4*	*P5*	*C1*	*C2*	*C3*	*C4*	*C5*
Off	7157	20178	9256	5132	X	1631	13763	587	64	X
Off	5404	7883	6668	2480	12141	136	9708	14	32	7740
Off	4587	7090	3649	10	10225	48	5751	6	31	4664
Off	1717	3647	2354	9	8300	29	15	4	28	4083
Off	1653	862	79	4	6405	27	13	3	27	1994
Off	1380	39	21	1	14	14	8	1	10	1331
On	6920	2202	5331	41	11531	2704	23	690	1926	7479
On	6865	1892	1419	11	11223	132	19	10	40	7344
On	5974	486	984	9	7305	88	17	10	36	6440
On	5972	333	593	6	7048	23	11	10	22	3476
On	4312	93	396	4	5141	14	8	6	19	57
On	1274	29	357	3	16	12	5	2	14	51

P, practitioner; C, control. X indicates missing data point.

in frequency the more pronounced the electric component. The magnetic component of the EMF, if strong enough, can directly interact with the corona discharge and influence its characteristic shape when captured on film. The high-frequency component appears to be within the ultraviolet spectrum and is responsible for the blue-violet seen in the images.

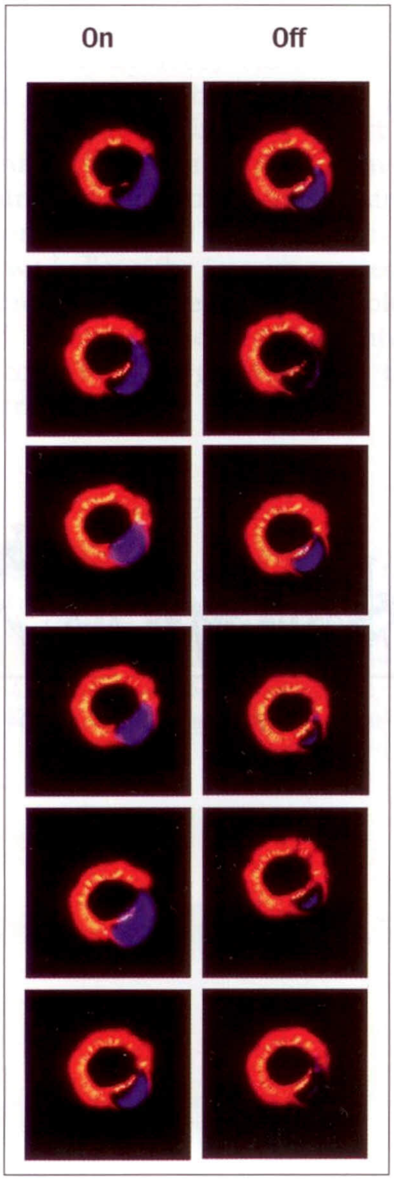
Demonstration of reproducible electromagnetic field changes within a biologic system leads to a discussion of the origin of these fields. Either the body has the ability to receive and focus ambient energy or the energy is derived from the composition of the body at the atomic level. Because all cells in the body have membranes the function of which includes the maintenance of an electrical gradient, the argument that these energies may be summated within organs or the organism has been made. Theories purporting the existence of biologically closed electric circuits have been investigated using fine-needle localization of malignant tumors in the hope of identifying differences between abnormal and normal cell growth (Nordenstrom, 1992). They hypothesize that a variety of closed circuit functions, commonplace in contemporary electronic technology, should have their correspondence in biology. An external magnetic field moving in relation to biologically closed electric circuits will produce a flow of current in the circuits. Moreover, a flow of current in a biologically closed electric circuit system will consequently produce electromagnetic fields.

Several limitations exist in our work. Our data are statistically significant although we lack an understanding of the mechanisms of the observed changes. Because of its controversial nature, this work should be reproduced in multiple centers prior to becoming widely accepted. Alterations of physiologic parameters such as temperature, blood pressure, and systemic oxygenation were controlled within a broad range, although the impact of minor changes is difficult to ascertain. Contrary to previous findings, we have experimented with long and short lapses in time between consecutive images and demonstrated no statistically significant differences between successive images under similar conditions. Finally, our observations that high-voltage electrophotography can be predictably altered should not be correlated with a healing function of transferred energy.

CONCLUSION

Our interest was threefold: (1) to determine whether corona discharge patterns could be reproducibly obtained and photographed, (2) to quantify some of the qualitative properties of the coronas, and (3) to determine if individuals can alter their electrophotographic images at will.

We found a correlation between change in the electromagnetic emissions for the body and the conscious desire of an energy practitioner to change their state. Analyses of individual finger coronas demonstrate statistically signif-



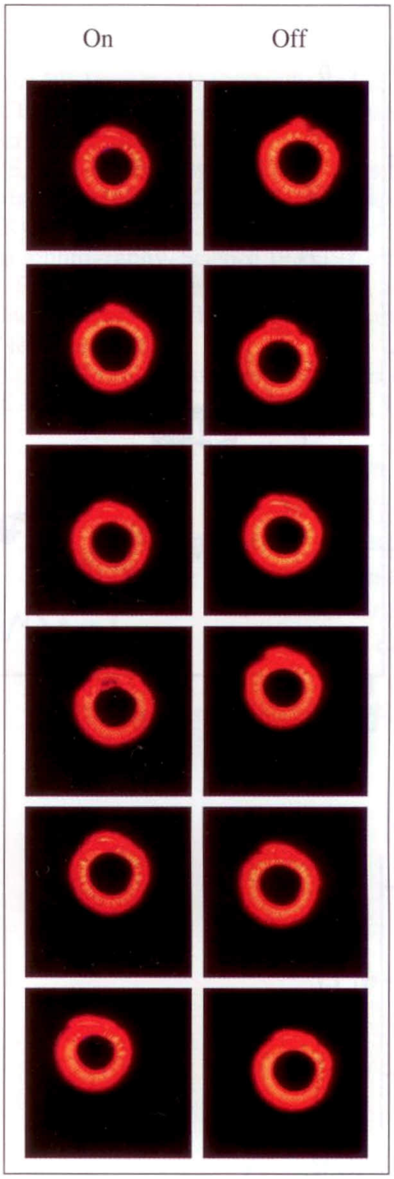


FIG. 10. (Left) Complete set of images from a series of "OFF" and "ON" measurements for a practitioner. Images displayed are not paired or displayed in order of successive images. "ON" images appear on the left and "OFF" images appear on the right. Note the increase of color in "ON" images and the disturbance of the corona discharge.
FIG. 11. (Right) Complete set of images from a series of "OFF" and "ON" measurements for a control. Note the absence of disruption of the corona discharge patterns and absence of blue-violet color in either "ON" or "OFF" states.

icant differences as analyzed by overall color changes and through analysis of individual sections of the various colors dominating the field. Control subjects were unable to reproducibly effect statistically significant changes. Physiologic processes, such as changes in skin resistance, sweating, and surface blood constriction have been suggested as an explanation of the colors and patterns that appear on the film in previous studies (Pehek et al., 1976; Tiller, 1974). These processes were controlled in our study and were not the cause of changed photographic patterns. In addition, physiologic alterations including temperature and blood pressure change were not observed in the practitioners when they created reproducible corona differences (Pehek et al., 1976; Tiller, 1974). Electrical parameters of the device, characteristics of the discharge waveform, electrical characteristics of the subject, film, and sur-

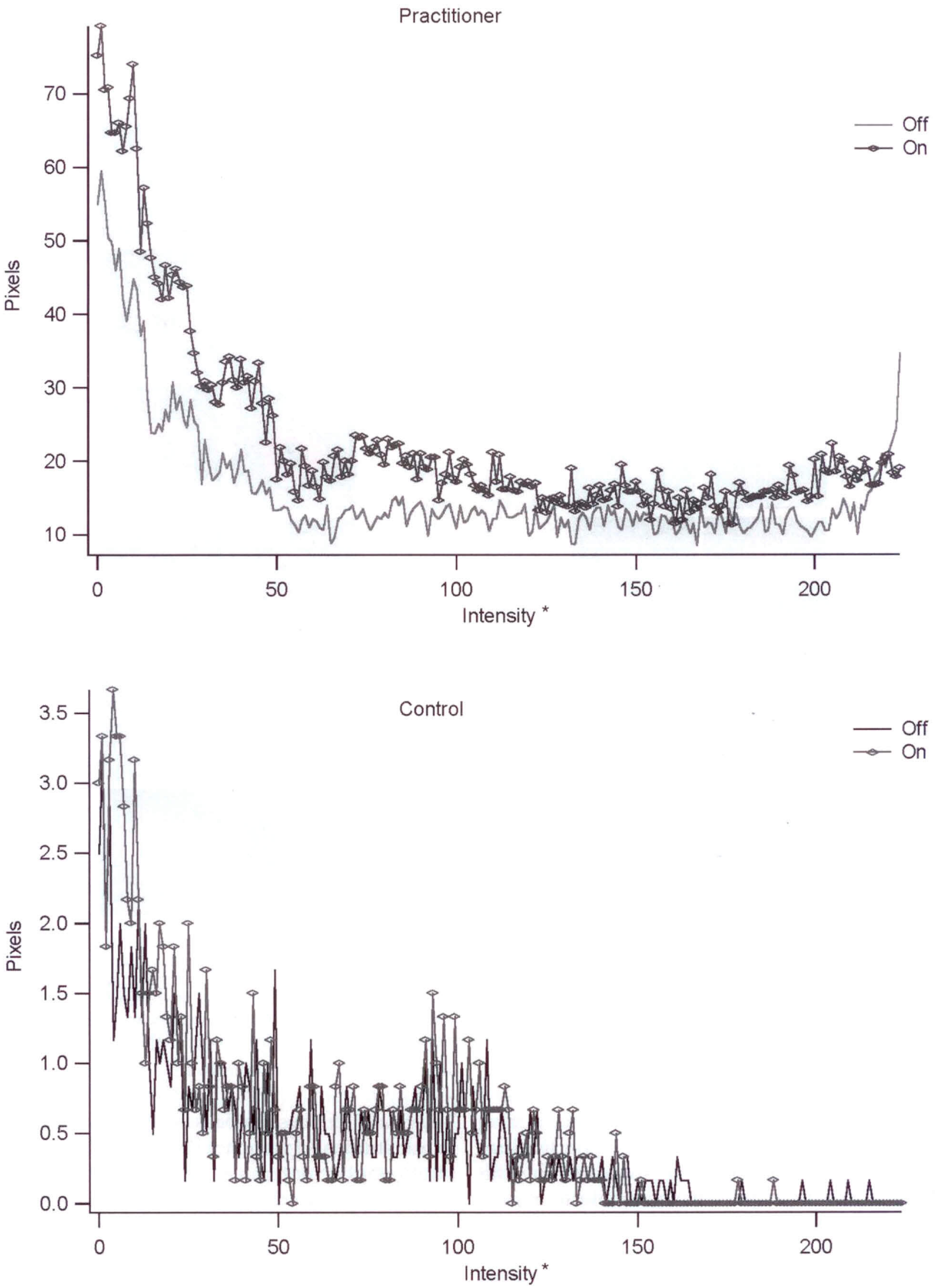


FIG. 12. This graph displays the averaged histogram data for the "ON" and "OFF" measurements of practitioner (top) and control (bottom) displayed in Figures 7 and 8 respectively. *Intensity refers to the brilliance of light at a particular area within the digitized image.

rounding atmosphere can influence the image (Wakins and Bickel, 1986). However, we identified and controlled the important physical variables, thus mitigating any effect on the corona image (Ebrahaim and Williams, 1982). After controlling the above variables and identifying reproducible and statistically significant changes, we believe the images created in our study represent the interaction of biologically generated electromagnetic fields interacting with the corona discharge created by the electrophotographic device.

REFERENCES

Eastman Kodak Company, Kodak Publication No. E-113, Kodal Ektachrome 100 Plus Profession film Tech Note, Eastman Kodak 1990.

Ebrahim H, Williams W. Kirlian Photography—An appraisal. J Audiovis Media Med 1982;5:84–91.

Kirlian SD, Kirlian VK. Photography and visual observation by means of high frequency currents. J Sci Appl Photography 1961;6:397–403.

Nordenstrom BE. Impact of biologically closed electric circuits (BCEC) on structure and function. Integr Physiol Behav Sci 1992;27:285–303.

Ostrander S, Schroeder S. Psychic Discoveries Behind the Iron Curtain. Englewood Cliffs, NJ: Prentice-Hall, 1970.

Pehek JO, Kyler HJ, Faust DJ. Image modulation in corona discharge photography. Science 1976;194:263–270.

Tiller WA. Energy field observations of man and nature. In: Kippner S, Rubin D, eds. The Kirlian Aura. Anchor Books, New York, 1974.

Wakins AJ, Bickel WS. A study of the kirlian effect. The Skeptical Inquirer, Vol 10, 244–257, Spring 1986.

Address reprint requests to:
Mark Russo, B.S.E.
705 Grant Street
Atlanta, GA 30315

E-mail: markrusso@atl.mediaone.net