

## Infrared imaging system as a versatile diagnostic and auxiliary treatment tool in Chinese Medicine

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**Abstract:** Many hot spots and hot lines seen in infrared images are found to correspond to inflammation of acupoints and meridians. So the surface body temperature at these hot spots and hot lines are indication of the state of health of internal organs where these meridians pass through. Five specific cases are given to illustrate how they are being done. The hot and cold spots, hot lines and hot areas found in infrared images can be identified broadly with the concept of hot and cold in the eight principal syndromes of Chinese Medicine.

### 1. Introduction:

Traditional Chinese medicine is a logically complete and philosophically sophisticate system that bases on the highest level of science in ancient time. When modern science is developed, especially in the last hundred year, with the discovery of molecules, atoms, photons, electrons, and ions, any substance, including human body, is known to be made up of these microscopic particles. They challenge the very foundation of Chinese medicine. How will Chinese medicine deal with this modern discovery? Many deep and valuable concepts that are very practical in the diagnostic and treatment of patients need to be revised, developed, and expanded. In the diagnostic arena, there are eight principal syndromes in Chinese medicine: yin and yang, interior and exterior, cold and hot, excess and deficiency. These traditional classifications are based on qualitative observational judgment of various syndromes of the patient. Attempts have been made to relate the power of various analytic tools in modern laboratory as well as modern biological understanding with these syndromes.( 1- 8 )

The production of easy to use, and economical medical grade infrared imaging systems in the last twenty years enable us, we believe, to elevate the diagnostic of cold and hot syndrome in Chinese Medicine to a new quantitative, objective level.

Many years ago it has been pointed out the infrared images are useful in studying meridians in Chinese medicine(9). Infrared imaging system has been used in Chinese medicine in association with acupuncture, qigong, moxibustion, and others since early 2000. (10-17).

Infrared images , or thermal images, or commonly called thermographs, are non-invasive, passive, harmless and easy to understand intuitively by physician and patients alike. They can be taken in seconds and produced immediately on computer monitor without causing any side effect on the patients. It is in fact like taking ordinary optical photographs. We have used it in conjunction with different modality of treatment in Chinese medicine with excellent results.

Infrared imaging is a map of body surface temperatures. From Western medicine view point, it is basically the properties of the skin, a record of the blood circulation of capillaries near the surface of the skin. But if we use meridian theory, then the skin phenomena is connected to the condition of internal organs via meridians. Hot temperature of the acupoints and meridians indicate inflammation of internal organs. Hence thermographs become a tool that can reveal the degree of inflammation of internal organs by the temperature measurement computed from the infrared images.

Furthermore when thermographs of a patient are taken before and 15 minutes after a particular treatment, comparison of the before and after pictures can yield information whether that particular treatment is effective or not. Hence both the physician and patient may know right away whether that particular treatment is appropriate for the patient.

Here in this paper we use the modality of stable water clusters (SWC) that has the shape of double helix shape. It has been hypothesized that SWC is the constituent of meridian system. Hence drinking SWC water and/or rubbing cream that has SWC in it will repair the meridians, enable qi to flow smoothly , and stimulate self-healing mechanism similar to the function of needles in acupuncture.(9,12,18).

## 2. Case studies:

Here we give five cases to illustrate the application of infrared imaging system in diagnostic and in evaluating quantitatively the effect of treatment with stable water clusters that have double helix shape (SWC). The treatment consists of drinking a 8oz of SWC and/or rubbing cream with SWC. Before the treatment a set of thermal images are taken. Fifteen minutes later after the treatment a second set of thermal images are taken. These two images are compared . Maximum temperatures of the hot areas are measured. For the first three cases the hot lines revealed in the first set of thermal images are associated with the inflammation along three different meridians: Stomach meridian, Kidney meridian, and Bladder meridian and hot spots are identified with acupoints. Fifteen minutes after the healing due to SWC, the maximum temperatures from the second set of images on these hot lines and hot spots are found to be reduced. Hence inflammation is reduced . In the fourth case the same treatment reduces the maximum temperature in some acupoints, but warming up in another very cold region 15 minutes after treatment. In the fifth case the very cold hands of a young woman warms up to their more normal values after four month treatment with SWC.

**A. Stomach meridian:** We had a 38 year old male subject ( code LA11M38BG)who had digestive problem. He also listed intestine problems, urinary problems, neck and low back pains, dental problems, and low energy (diagnosed with thyroid hormone imbalance) We took a set of thermographs of his face and frontal legs ( Fig 1and Fig 2). There were hot spots along the stomach meridians, which we identified with acupoints. They were left and right acupoints ST 4 at the two corners of the mouth, left and right ST12 at the inside of upper collar bone areas, and left and right ST 41 on the frontal side of the ankles. The broad hot lines between ST 36 and ST37 on the frontal legs were identified to be segment of stomach meridian. We measured the maximum temperatures in these local hot spots before and 15 minutes later after he drank the stable water clusters (SWC). They were listed in Table 1. The difference of these maximum temperatures were also calculated and shown in the last column of the table. Negative values of the difference means they are cooling off. The cooling amount is given by the differences in maximum temperatures. They ranged from -0.1 to -1.1. Out of ten values, eight of them are more negative than -0.2C. The statistical fluctuation of skin temperature is +/- 0.1C. So eight of them are two standard deviation more than statistical fluctuation, and can be considered statistically significant. The cooling of inflammation is quite common identified as being less inflammation, and hence beneficial to the health of the subject immediately.

It is quite clear the same methodology can be used to find out whether other modality of treatment such as acupuncture is effective in healing a patient (10).

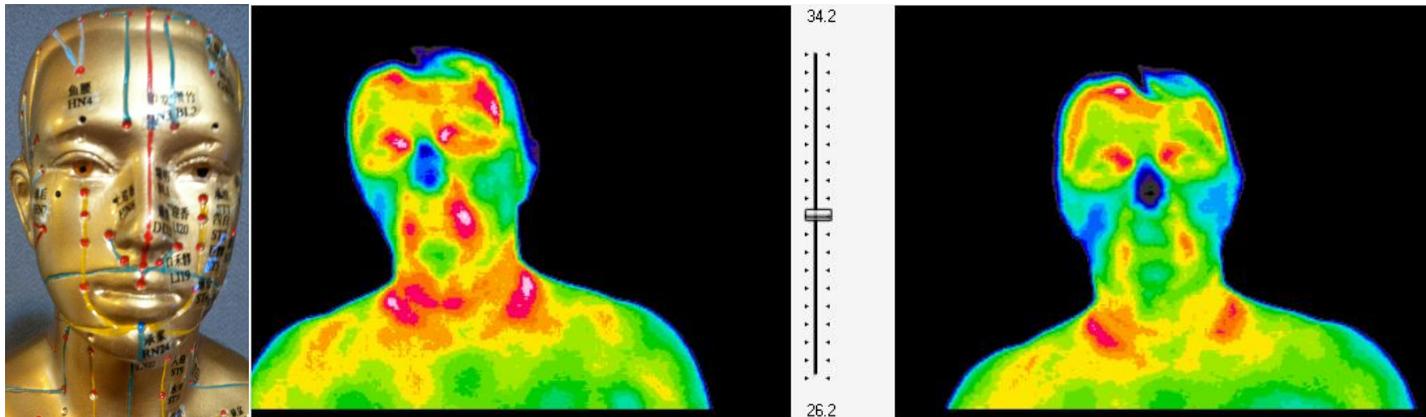


Fig 1: Thermal images for subject LA11M38BG :

Left image is the face of the subject before drinking DHW and right image shows 15 minutes after drinking 8oz SWC. The color code of thermal images are : white being hottest, then red, yellow, green, blue with black the coldest. The quantitative values of maximum temperatures on hot spot are tabulated in Table 1. The image on the far left shows the standard official position of meridians and acupoints on the face for easy comparison. Similar images of standard meridians and acupoints are included in the other figures on the far left.

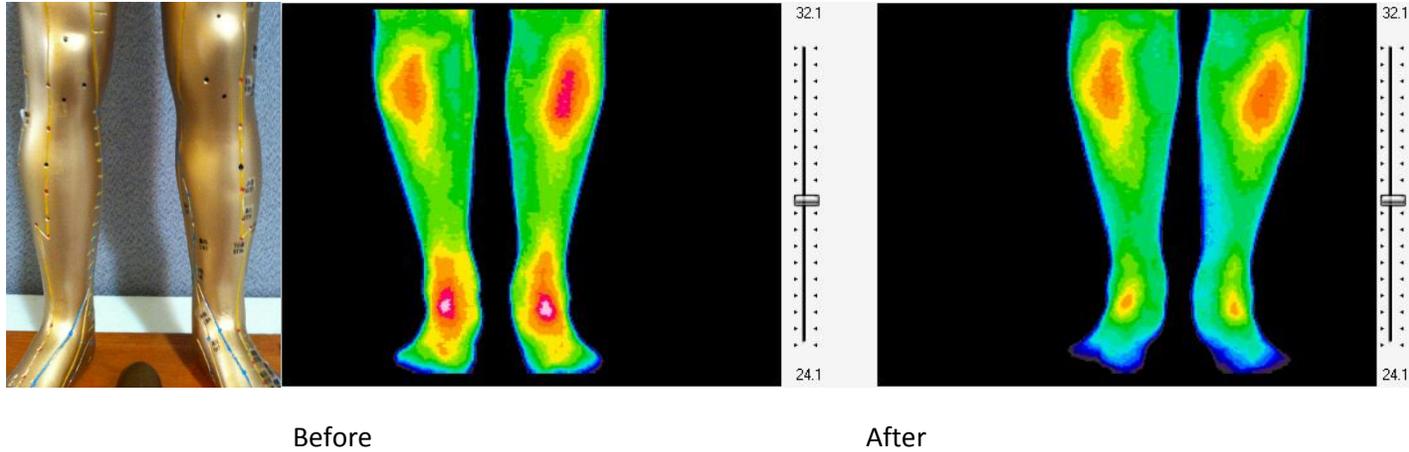


Fig 2. Thermal images of subject LA11M38BG:

Left image shows patient before drinking DHW and right image shows 15 minutes after drinking 8oz DHW. Maximum temperatures were recorded in both before and after images. They are tabulated in Table 1.

Table 1: Maximum temperatures of thermal images of subject LA11M38BG shown in Fig 1 and Fig 2

LOCATION	Max Temp T <sub>1</sub> (°C) Before drinking swc	Max Temp T <sub>2</sub> (°C) 15 min after drinking SWC	T <sub>1</sub> - T <sub>2</sub> (°C) Difference in max temp
Left BL1 (corners of eye)	33.8	33.5	-0.3
Right BL1	33.8	33.5	-0.3
Left ST4 (corners of mouth)	34.0	33.1	-0.9
Right ST4 (corners of mouth)	33.6	32.9	-0.7
Left ST12 (collarbone/thyroid)	33.9	33.5	-0.4
Right ST12 (collarbone/thyroid)	33.9	33.7	-0.2
Left ST36, 37 (below knee)	31.7	31.3	-0.4
Right ST36, 37 (below knee)	31.2	31.1	-0.1
Left ST41 (between inner and outer ankles)	31.9	30.8	-1.1
Right ST41 (between inner and outer ankles)	31.8	30.8	-1

## B. Kidney Meridian :

We have a 50+ year old male subject LA11M44EG Patient diagnosed as being pre-diabetic with metabolic syndrome. He also complained of sleep apnea, tremors, and difficulty with his memory. . In many other cases similar

to this subject we notice that people with diabetes or pre-diabetes have a hot ring around the mouth as shown in Fig 3: a large intestine segment above the mouth and a hot stomach meridian segment below the mouth. There are four hot spots around the ring, which corresponds to LI 19 for the upper two hot spots, and ST 4 for the lower two hot spots. For people with diabetes, their kidney also has malfunction. When we took the pictures of the inner side of his legs as shown in the middle row of Fig 3, we found a ring like hot spot around the ankle, which we identified as kidney meridian. In Chinese medicine weakness of kidney often reflects on weakness in the back. When we took pictures of the lower back as shown in the bottom row of Fig 3, there was a cold area in GB25 area. The coldness of GB25 area then is interpreted as weakness of kidney meridian.

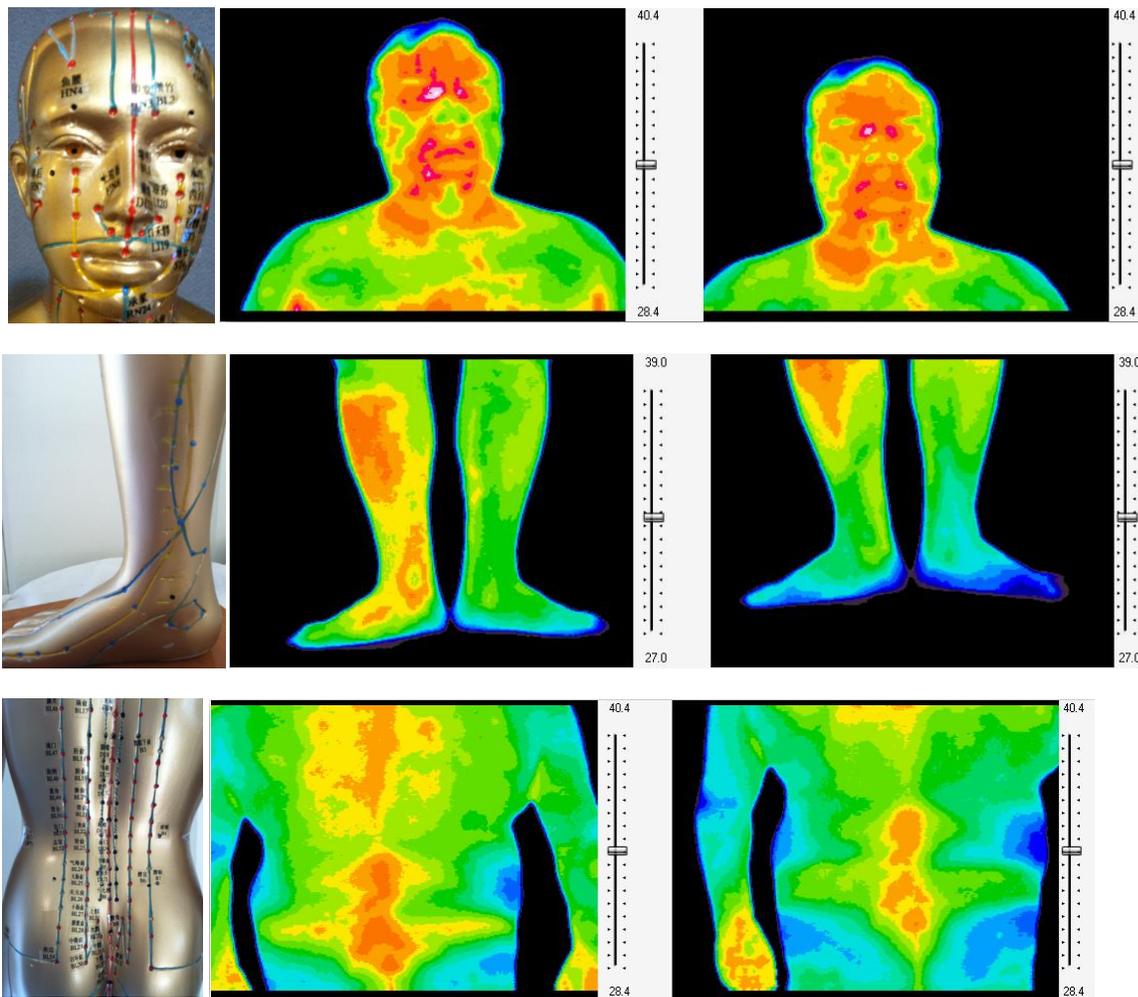


Fig 3. Thermal images of 50+ year old male subject with pre-diabetes.

The top row were face images , the two rows the inside of two legs, and the bottom row the lower back, where the left ones were taken before and the right ones taken 15 minutes later after drinking the SWC.

Table 2: Maximum temperatures of thermal images of subject LA11M44BG shown in Fig 3.

LOCATION	Max Temperature T <sub>1</sub> (°C)	Max Temperature T <sub>2</sub> (°C)	Difference (°C) T <sub>1</sub> - T <sub>2</sub>
Left ST4	39.4	39.5	+0.1
Right ST4	39.5	39.5	0.0
Left LI19	39.1	39.1	0.0
Right LI19	39.5	39.4	-0.1
Left K14	35.5	34.6	-0.9
Right K14	37.1	35.7	-1.4
Left GB25	34.7	34.7	0.0
Right GB 25	35.3	34.1	-1.2

### C. Spleen meridian

A 65 year old male ( LA11M47HJ) listed his health problems being weak lungs, rectal bleeding possibly due to hemorrhoids, low testosterone levels, and hip fracture. These problems would result in an overactive immune system that was directly related to spleen function. The spleen meridian (SP) runs from the foot up to the calf, as shown in Fig 4. Maximum temperatures were measured at acupoints SP5 before drinking 8 oz SWC and 15 minute after drinking 8oz SWC. They were shown in Table 3. The maximum temperatures as measured at SP5, which were reduced from 31.7°C to 30.3°C for the left leg by 1.4°C, and from 32.4°C to 30.6°C by 1.8°C. The cooling down is significant because the statistical fluctuation is only 0.1°C.

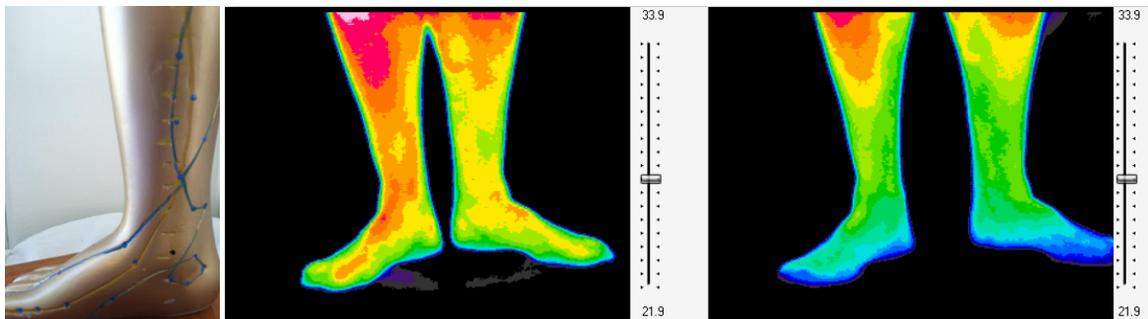


Fig 4 Thermal images of a 65 year old male subject .

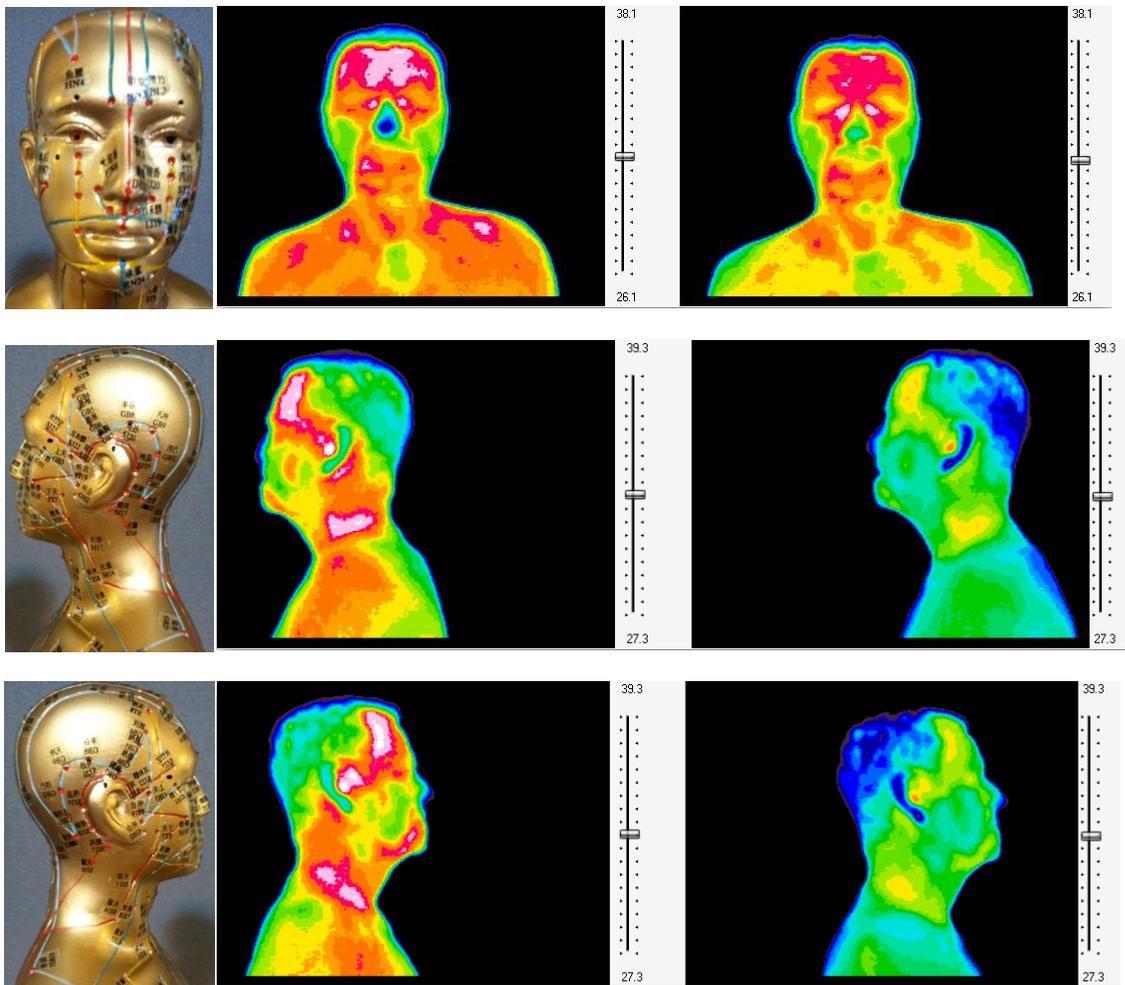
The left image was taken before and the right image was taken 15 minutes later after drinking the SWC.

Table 3 Maximum temperatures of hot spot at SP5 of subject LA11M44BG as shown in Fig 4.

LOCATION	Temperature T <sub>1</sub> (°C)	Temperature T <sub>2</sub> (°C)	Difference T <sub>1</sub> - T <sub>2</sub> (°C)
Left SP5	31.7	30.3	-1.4
Right SP5	32.4	30.6	-1.8

### D. Warming up and Cooling down simultaneously

A 66 year old male ( code LA11M46SL ) , who said he was quite healthy. But under questioning he did have many illness: irritable bowel syndrome IBS, bi-polar, psoriasis, and lower back pain due to a bulging disc., low thyroid activity, stress dermatitis. The irritable bowel syndrome would reveal itself as hot spot at BL1, the inner corners of two eyes, which is shown in top row of Fig 4. The maximum temperatures of these hot spots actually increased, which indicated that they were deteriorating if left untreated. We learned from other cases that thyroid malfunction showed itself also as hot spot at ST12. The lower activity of the thyroid also showed itself most prominently as small segment of horizontal hot lines between the neck and the shoulder as seen on second and third row of Fig 4, which we identified as Small Intestine Meridian segment. These hot spots and hot lines decreased their temperatures to become cooler 15 minutes after the subject drank SWC and rubbed the cream that contained SWC. When we took the pictures of his two hands, as shown at the bottom row of Fig 4, we found that his hands were exceptional cold. The subject confirmed that he had cold hands for many, many years, probably from childhood. Very cold hands certainly were not normal. Fifteen minutes later another infrared picture was taken of his two hands. The maximum temperature of the right hand showed an increase of 5.5<sup>0</sup>C, which was enormous warming. The left hand , nevertheless, remained the same. The implication was that his left hand probably was in a much worse condition than his right hand. If the subject continued the healing process with the SWC, we expected that his right hand would become warmer much sooner than his left hand. The maximum temperatures of various hot spots before and 15 minutes after the healing of SWC are listed in Table 4. There are four pairs of acupoints that we measured: left and right BL1( corner of the eyes), left and right ST4( corner of the mouth), left and right ST12( collar bone area), and SJ21( inner center of ear lobe). The BL1 showed slight warming by 0.1<sup>0</sup>C and 0.3<sup>0</sup>C. The other three pairs showed much more cooling down up to 2.1<sup>0</sup>C.



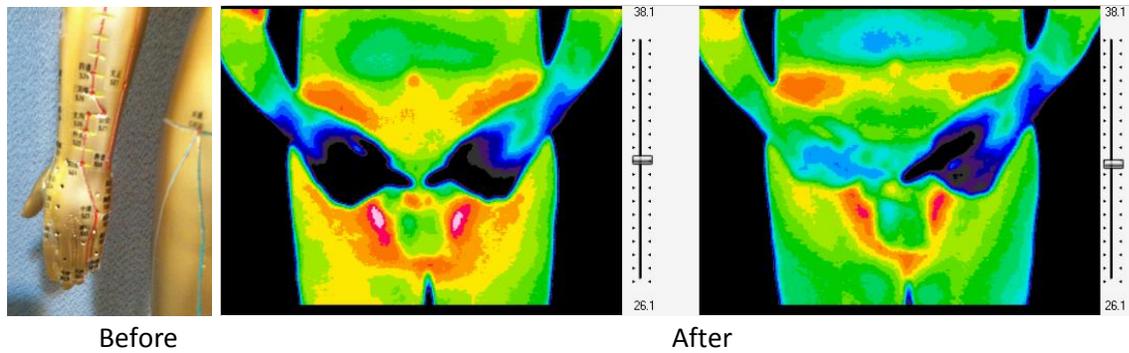


Fig 5 Thermal images of a 66 year old male subject ( LA11M46SL).

The top row were face images . The second and the third rows were images of the right and left side of the head, and the bottom row showed the images of two hands. The left images were taken before the healing with SWC, and the right images were taken 15 minutes later after treatment with the SWC.

Table 4: Maximum and minimum temperatures of hot spots taken of subject LA11M46SL before and after treatment with SWC as displayed in Fig 4.

LOCATION	Max Temperature T <sub>1</sub> (°C)	Max Temperature T <sub>2</sub> (°C)	T <sub>1</sub> – T <sub>2</sub> Difference (°C)
Left BL1	37.4	37.5	+0.1
Right BL1	37.4	37.7	+0.3
Left ST4	36.7	36.6	-0.1
Right ST4	37.1	36.9	-0.2
Left ST12	37.4	36.3	-1.1
Right ST12	37.2	36.8	-0.4
Left SJ21	39.6	37.5	-2.1
Right SJ21	39.6	37.6	-2.0
Left Hand*	27.6	27.6	0.0
Right Hand*	26.0	31.5	+5.5

\*minimum temperatures taken

### E. Long term warming up of cold hands

A 26 year old young woman whose health was optimal, had exceptional cold hands and cold feet with occasional aches and pains in the joints. The young woman led an active lifestyle participating in surfing and rock climbing activities for the past few years. Cold fingers and cold hands were directly related to activities practiced.

Thermo-images in Fig 5 showed long-term improvement of the young woman, whose hands had benefited from drinking SWC and the application of SWC cream. The thermal image on the left taken in August 2010 showed young woman's hands and face without having had any healing from SWC. The thermal image on the right was the follow-up picture taken in December 2010 after 4 months of consistently drinking SWC two times a day and applying SWC cream 3 times a day. In the initial study the difference in the face and hand temperature was -2.7°C. In the follow-up study (right image) the difference between the face and the hand temperature was -0.2°C. There was considerable warming 2.5<sup>0</sup> C of the hands relative to the face.

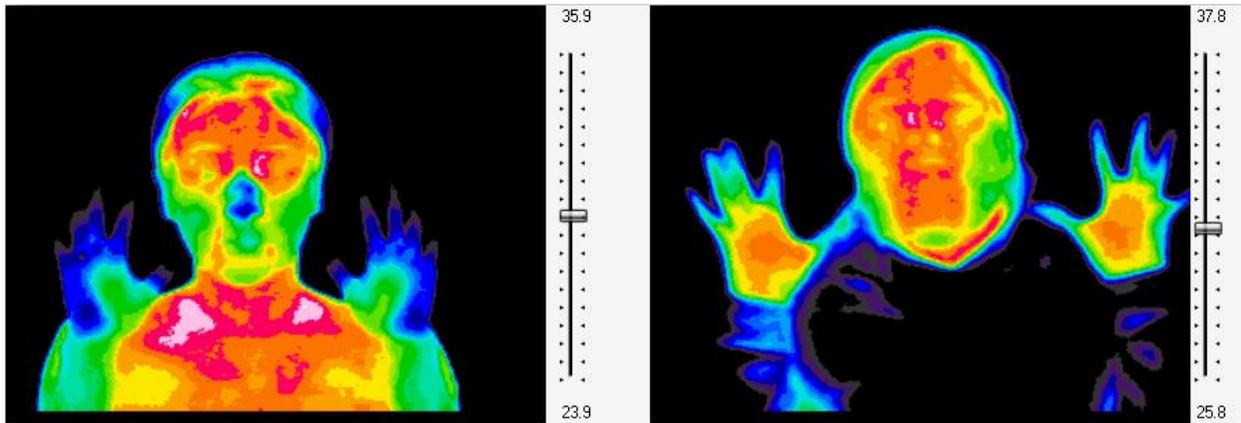


Fig 5 Thermal images of 26 year old woman.

The left image of the face and hands was taken in August 2010 before healing with SWC. The right image of the face and hands was taken in Dec 2010 after healing with SWC water and cream. The warming of the hands relative to face is 2.5<sup>o</sup> C.

Table 5. Maximum temperatures of the hand and face of a young woman whose thermal images were taken in Aug 2011 and Dec 2011

Date taken	Maximum Eyes Temperature $T_e$ (°C)	Maximum Hand Temperature $T_f$ (°C)	Difference $T_e - T_f$
August 2011	35.2	32.5	-2.7
December 2011	36.8	36.2	-0.2

### 3. Discussion

- a) Thermal images are able to show the hot and cold body surface temperature locally with quantitative accurate numbers. The hot spots and hot lines on the body surface could be identified with acupuncture points and meridians in Chinese medicine. Hence we can attribute the hot and cold syndrome in Chinese medicine with new quantitative, objective numbers of local temperature.
- b) The meaning of hot acupoints and hot meridians as revealed by thermal images sometimes coincide with traditional syndromes of hot and cold. But often time the meaning may be different from the traditional ideas of hot and cold syndromes. We suggest that we explore these new meanings to enrich our understanding of the function of acupoints and meridians.
- c) When we take another set of thermal images at as quick as 15 minutes later after a particular treatment, we may find out whether the treatment has the desired effect or not immediately. The patient may also have more confidence of that particular modality of healing when he sees quite significant qualitative changes in the color of the thermal images, because the color in thermal images conveys intuitive meaning. We generally tuned the color of the thermal images so that green color indicates a state of good health. White is the most inflamed, and red is the second inflamed. The hot spots and area where they are white or red are problems area that need to be taken care of.
- d) One of the most fundamental aspects of health in Chinese medicine is the idea of balance. Neither too much (excess, or too hot), nor too little (deficiency, or too cold) are normal. Any modality of healing must be bi-directionally. For a too hot region it should cool down. For a too cold region, it should heat up. We find that the needle in acupuncture can do that. The treatment with SWC also could do that.
- e) For illustrative purposes we only show five cases here. The message is quite general. We have actually scanned more than five hundred persons, healthy and unhealthy, young and old, and obtained thousands of pictures. Everyone has some hot spots that correspond to well known acupuncture points. Majority of them have hot lines that correspond to meridians.

### 4. Conclusion:

Infrared image system is a non-invasive, passive system. It costs much less than a CT or MRI machine. The thermal images of scans come out immediately. The color pictures of the thermal images can be understood intuitively by a reasonable person. They take on great meanings when combined with meridian theory and syndromes analysis in Chinese medicine.

The weakness of infrared images is that it is non-specific. There is seldom one to one precise correspondence between the maximum or minimum temperatures with the severity of a particular health problem. But when combined with other analytical tools, the knowledge or insights of the patients they become very powerful tool for determining what treatment to use, and know t whether the treatment is effective both immediately in fifteen minutes and in a much longer period.

In a period of almost ten years after scanning hundreds of subjects, and taking thousands of infrared pictures, we find that the identification and correlation of hot spots, hot lines, and hot regions with acupuncture points, meridians, and the concept of hot and cold syndrome in Chinese Medicine is a very fruitful one. It is recommended that others research workers and practitioners to pursuit using thermal scans in many more subjects with many different kinds of illness.

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