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# Thermal Imaging Analysis for Acupuncture Needling Study by Thermal Graphic Data Based on the Large Intestine Meridian of Hand Yangming's and the Lung Meridian of Hand Taiyin's Acupoints

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# ABSTRACT

Meridians systems are the pathways of qi and blood of TCM (Tradition Chinese Medicine). These systems include twelve regular meridians and eight extra meridians. The five Shu-points, namely the Well, Spring, Stream, River, and Sea, are an important grouping of acupuncture points of the twelve regular meridians. Five Shu-points on each Meridian located below the elbow and the knees are therapeutically pivotal in most styles of acupuncture needling. The Sea points of both the Yin and Yang meridians are among the most important acupuncture points for treating disorders. In order to explain the mechanism of meridian theory, infrared imaging (or thermal imaging) is one of techniques to investigate the phenomena of sensation transmission along channel in channel vessel theory. Assumed the qi can be shown by the thermal imager, based on the thermal graphic data the thermal imager was used to detect the temperature variation by needling the Sea points of a pair of Yin and Yang meridians named Large Intestine meridian of Hand Yangming and Lung meridian of Hand Taiyin. In this paper, it will show the temperature variations of Stream points of the chosen meridians are different by needling the Sea points of their corresponding meridians. And we can see the needling the Sea point of Yang meridian induced a temperature rising of its correlated Stream opint. But needling the Sea point of Yin meridian deduced a temperature falling of its correlated Stream one.

Keywords: Chinese medicine, Meridian, Acupuncture, Thermal image

# INTRODUCTION

Human body stays at a stable temperature. When the body is suffering from disease, the thermal equilibrium will be disturbed; therefore, the change of body temperature is one of the indicators of clinical diagnosis of disease. The infrared thermal imager can display surface temperature of the body. If body thermal image of the patient with the disease compare with the normal physiological state one, we can determine the pathology by the differences displayed by thermal image. British scientist Frederick William Herschel discovered infrared radiation on 11 February 1800 [1-8]. When using a red filter, he found there was a lot of heat produced. Herschel discovered infrared radiation in sunlight by passing it through a prism and holding a thermometer just beyond the red end of the visible spectrum. Thermal imaging technique used infrared radiation theory to analyse the temperature distribution of body surface. Electromagnetic waves can display the outline of the target object as long as its temperature is higher than the absolute zero and even can see the phenomena of tumour in body and the flow of blood by thermal imager [9-15].

Thermal imaging is very valuable in the study of TCM, it is an effective method for studying the acupuncture theory and the phenomena of channels and network vessels. In the procedure of treating patients by acupuncture, the thermal images were recorded in every stage, including beforehand acupuncture stage, needle retention stage and remove the needle stage and compared their extent of increasing temperature, the range of increasing temperature and the feature of increasing temperature with each other. Human body is a natural infrared radiation source, its infrared radiation band is  $3-50 \mu m$  (visible light band is  $0.4-0.7 \mu m$ ). As a result, we used infrared thermal imager based on infrared

radiation theory to detect infrared radiation of human body and take it as radiation resource. After signal processing of photoelectric conversion, we can convert thermal images of invisible infrared of the body surface to corresponding temperature [16].

### MATERIALS AND METHODS

By comparison method, the infrared thermal imager TAS-G100EXD (Temperature resolution: 0.04°C, Band: 8-14 µm) was used to detect six acupoints' temperature from Hegu (LI-11, Joining Valley, also known as source) to Quchi (LI-4, Pool at the Crook, also known as He-sea point which belonged to the Large Intestine channel of Hand Yangming [17,18]. Figure 1 shows visible light figure (right) and thermal image (left).



Figure 1 Visible light figure (right) and thermal image (left)

Along sides, we also used control group method to explore the effect of acupuncture on the acupoints of channel vessel. The measuring time for each experiment is approximately 40 minutes. The recording steps are set in five steps:

(1) 5 minutes before needling $\rightarrow$ (2)needling $\rightarrow$ (3)needle twirling 1,2,3,4  $\rightarrow$ (4)remove needling $\rightarrow$ (5)5 minutes after removing needling.

### RESULTS

### Temperature measurement of the Large Intestine meridian of Hand Yangming's acupoints

Under the guidance of Professor Zhang, Dr. Li randomly selected Chinese Traditional Chinese Medicine graduate students of Chinese Medical University, measured 1 to 6 acupoints of the Large Intestine channel of Hand Yangming named: Hegu (*Source point*, LI-4, R1), Yangxi (LI-5, R2), Calendar (LI-6, R3), Wen Liu (LI-7, R4), Shang Lian (LI-8, R5), and Quchi (*Sea point*, LI-11, R6), as shown in Figure 2.



Figure 2 Temperature measurement of the large intestine meridian of hand Yangming's acupoints

By the assistance from Dr. Chang and Dr. Lee, the temperature changes of large intestine of hand Yangming's acupoints were measured by TAS-G100EXD. In case #1, inserting the needle into right hand's *Sea point* (R LI-11, Quichi), and using the thermal Graphic Data method, we can record the temperature changes from the first acupoint (Hegu, LI-4) to the sixth acupoint (Quichi, LI-11) as shown in Figures 3a and 3b.



Figure 3a #1, right hand's temperature (T) changes by needling R LI-11



Figure 3b #1, left hand's temperature changes by needling R LI-11

Analyzing Figures 3a and 3b, we can see if we insert the needle into the right hand's Quichi (R LI-11), the temperature of remote *source point* (LI-4) will be raised. Additionally, needling into the right hand and the temperature changes of the left hand is similar to those of the right hand (including the temperature variations and curve type). In order to explore this phenomenon, the case #2 was chosen as needling into the *Sea point* (LI-11) of right hand of the Large Intestine meridian of Hand Yangming as well, and the thermal images were recorded by the same sequence as case #1, shown in Figures 4a and 4b.



Figure 4a #2, right hand's temperature changes by needling R (right hand) LI-11



Figure 4b #2, left hand's temperature changes by needling R LI-11

Compare Figures 3a and 3b with Figures 4a and 4b, we can see needle into the *Sea point* (LI-11) of Large Intestine meridian of Hand Yangming induced the temperature rises of remote *Source point* (LI-4).

In order to clarify the temperature raised effect of needling the *Sea point*, the control group method was used to measure the temperature variation of sham needling by case #3, the results were shown in Figures 5a and 5b.



Figure 5a #3, right hand's temperature changes by sham needling



Figure 5b #3, left hand's temperature changes by sham needling

For further to realize the needling effect of temperature changes by needling into He-sea point of Large Intestine meridian of Hand Yangming, we used "proof by contradiction" (Assuming that the opposite proposition is true, and then shows that such an assumption leads to a contradiction). Then inserting into the *Source point* (R LI-4) of the right



hand of Large Intestine meridian of Hand Yangming rather than the *Sea point* (LI-11), and we can see the temperature changes from the *Source point* (point 1) to the *Sea point* (point 6). The results were shown in Figures 6a and 6b.

Figure 6a #4, right hand's temperature changes by needling R LI-4



Figure 6b #4, left hand's temperature changes by needling R LI-4

### Interpretation of temperature changes of the Large Intestine meridian of Hand Yangming's acupoints

According to Figures 5a and 5b, we can see if there is no needling, the temperature changes of the *Source point* (LI-4) of the Large Intestine channel of Hand Yangming shows a variation between  $\pm 2.0$  °C. The results as shown in Figures 7a and 7b.



Figure 7a Temperature variation of right hand side by shame needling



Figure 7b Temperature variation of left hand side by shame needling

However, if we insert the needle into the sea point (LI-11) shown in Figure 2, the temperature changes of the *Source point* (LI-4) of the Large Intestine channel of Hand Yangming shows a variation from +6°C to -3.0°C The results were shown in shown in Figures 8a and 8b.



# Figure 8a Temperature variation of right hand side by needling the sea point of the large intestine meridian of hand Yangming



Figure 8b Temperature variation of left hand side by needling the sea point of the large intestine meridian of hand Yangming

### Temperature measurement of the Lung meridian of Hand Taiyin's Acupoints

The first chapter of Huang Di Nei Jing (or The Yellow Emperor's Inner Classic" said: "keep open their conduits and vessels, to harmonize blood and qi, and to keep those locations in good order where their flow contrary to or in accordance with the norms occurs and where leaving and entering take place". We can see insert the needle into the *Sea point* (LI-11) of the Large Intestine channel of Hand Yangming's acupoints in section 1, and the *Source point's* (LI-4) temperature was increased obviously. This seems to meet: "what is known as *Sea point*, it had difference of Yin and Yang channel". Is there any difference by needling the He-sea point of yang and Yin meridians? Yang meridian is copious of qi and blood, then the temperature of Source point is increased by needling the *Sea point*. Now, we are interesting how the temperature changes if needling the *Sea point* of Yin meridian. Here we chose the counter meridian of the Large Intestine meridian of Hand Yangming, i.e., the Lung channel of Hand Taiyin. The pathway of the Lung channel of Hand Taiyin was shown in Figure 9.



Figure 9 The Lung meridian of Hand Taiyin

In case #5, the temperature changes of the acupoints of the five shu-points by needling the *Sea point* (R LU-5) of the Lung meridian of Hand Taiyin shown in Figures 10a and 10b. The abscissa digits represent: 1. Well (Lesser Shang (LU-11), R1) 2. Spring (Fish Border (LU-10), R2) 3. Stream (Great Abyss (LU-9), R3) 4. River (Channel Ditch (LU-8), R4) 5. Sea (Cubit Marsh (LU-5), R5).



Figure 10a #5, right hand's temperature changes by needling R LU-5



Figure 10b #5, left hand's temperature changes by needling R LU-5

In order to explore its commonality, in case #6 we still pricked the needle into the *Sea point* (R LU-5) of the right hand of the Lung meridian of Hand Taiyin. The temperature changes of case #6 were shown in Figures 11a and 11b.



Figure 11a #6, right hand's temperature changes by needling R LU-5



Figure 11b #6, right hand's temperature changes by needling R LU-5

### DISCUSSION

From the graph data by the thermal image measurements discussed above, we can see the temperature changes of *source point* is varied in different ways because of its belonging meridian. In Yang meridian, e.g., the Large Intestine meridian of Hand Yangming, the temperature of its *source point* is increased obviously by needling the *sea point*. Relatively, if needling the sea point of Ying meridian, e.g., the Lung meridian of Hand Taiyin, the temperature

changes of *source point* is decreased in a small amount. By graph data, we can also see needling the acupoint of right hand gives the similar temperature changes pattern of both right' and left' hand acupoints.

If we assume the temperature is one of the ways to show the essence of qi or blood of TCM. Then we can predict the *source point* of Yang meridian plays a more important role than that of the Yin meridian.

### CONCLUSION

In order to further understanding the impact of acupuncture on the meridians, we can continue to explore the temperature changes of acupoints in the following:

1. Needling the sea point of the Large Intestine meridian of Hand Yangming induced the temperature increase of acupoints of meridians, and the highest point was on the source point. This phenomenon needs more individual cases to verify.

2. Will needling the sources points of the two other Hand Yang meridians induce the rising temperature of their corresponding source points?

3. Needling the sea point of the Lung meridian of Hand Taiyin induced the temperature decrease of acupoints of meridians. This phenomenon needs more individual cases to verify.

4. Will needling the sources points of the two other Hand Yin meridians induce the temperature decreased of their corresponding source points?

5. If the temperature varies form of the pair of the Foot Yin and Yang meridians are similar to that of the pair of the Hand Yin and Yang meridians.

### DECLARATIONS

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