Preferential Direction and Symmetry of Electric Conduction of Human Meridians

Bilaterally Symmetrical Acupoints Provide Better Conductance for a Better "Connection"

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Acupuncture meridian system theory is one of the main features of traditional Chinese medicine (TCM). The meridians are thought to be the pathways for *qi* (or bioenergy), which then circulates throughout the human body. They originate in the internal organs and from there travel up to the skin.

Bilaterally opposite, symmetric acupunctures along the main meridians (called Great Acupuncture) and along the branching meridians (called opposite insertion) are two traditional methods of acupuncture commonly used in clinics. Symmetric acupoints are punctured opposite to the diseased or affected side. This article discusses our work in which we used 80 healthy subjects to study the symmetry or preferred direction of electrical conduction of human meridians. The data were then analyzed by paired-t and ANOVA testing procedures.

Studying Electrical Conductance

The properties of higher electrical conductance, or the potential, of acupuncture points were first discovered by Nakatani in 1950 [1], and were subsequently confirmed by Niboyet [2] and Zhu [3]. Podshibiaky [4] in 1955 reported that they found some active skin points. However, such findings remain controversial. In 1975, Reichmanis, et al. [5], designed a matrix electrode that allowed constant skin contact pressure to be achieved. Their double-blind studies proved, once again, the low resistance property of acupuncture points. [5]

Using the electrical properties of acupoints, Reinhold Voll [6] designed an instrument called the Dermatron to measure these properties, and he has continued to supplement his clinical diagnosis and therapy since the early 1950s [6]. Now, this testing method has developed into the electrodermal screening test (EDST). The scientific basis of EDST was presented by Chen [7] in 1996.

TCM supports the theory that 12 meridians are distributed in a bilaterally symmetric manner throughout the body. The qi and blood are thought to form a physiological rhythm. For a long time this system was used qualitatively in clinics, but until the introduction of EDST, no quantitative indicator had ever been found to show this rhythm.

From the experimental studies of Chen [7], the meridians can be viewed as good pathways for electrical conduction and electromagnetic (EM) wave propagation. Preferential directions for electrical conductance and EM wave propagation along the meridians also exist. This study tried to determine the electrical symmetry of bilateral meridians. However, asymmetrical properties were found that were a previously unknown aspect of classical meridian theory.

Our study measured the difference of conductance for different directions of applied voltage at both symmetrical acupoints (*Wai-Kuan, Ta-Ling*) and asymmetrical acupoints (left *Tien-Ching* / right *Wai-Kuan*, left *Ta-Ling*/right *Kung-Tsui*, left *Kung-Tsui*/right *Ta-Ling*) of the limbs.

Materials and Methods

The electrodes used in our study were copper buttons of 2 mm diameter and 3 mm thickness. A thin layer of conductive gel was used on the electrodes in order to reduce skin surface resistance. The voltage used was 1.5 volts DC. All data were recorded by a personal computer and the peak response currents were read automatically by analytical software, following the concepts of Chen's biophysical model. [7].

The symmetrically paired acupuncture points are (1) *Wai-Kuan* to *Wai-Kuan* (Triple Warmer meridians), (2) *Ta-Ling* to *Ta-Ling* (Pericardium meridians), and (3) *Kung-Tsui* to *Kung-Tsui* (Lung meridians). The asymmetrically paired acupuncture points are (1) right *Wai-Kuan* to left *Tien-Ching*, (2) right *Ta-Ling* to left *Kung-Tsui*, and (3) left *Ta-Ling* to right *Kung-Tsui*. The location of the acupuncture points followed the classical criteria of TCM.

The 40 subjects of group A were sampled from people visiting Taipei Municipal Ho-Ping Hospital. 22 male and 18 female subjects were invited to take part. Ages ranged from 18 to 53 with the average being 30.18 ±7.82. The experiments of *Wai-Kuan* to *Wai-Kuan* (A1) and right *Wai-Kuan* to left *Tien-Ching* (A2) were studied in this group.

Another 40 subjects (group B) were sampled for the experiments of *Ta-Ling* to *Ta-Ling*(B1), right *Ta-Ling* to left *Kung-Tsui* (B2) and left *Ta-Ling* to right *Kung-Tsui* (B3). This group consisted of 21 males and 19 females, with ages ranging from 18 to 42. The average age was 26.38 ± 6.13.

The subjects were asked to relax and sit down quietly with their hands in their laps during the measurement. All acupuncture points were cleaned with alcohol before the attachment of the electrodes with conductive gel. Adhesive (3M) tape was then used to fix the electrodes onto the skin. A DC voltage of 1.5 volts was applied to the acupoints. Measurements

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Table 1

Study Type	A1	A2	P value	A1	A2	P value
Current Direction	Right Hand ↓ Left Hand			Left Hand ↓ Right Hand		
Mean Conductance (μA)	2.89±2.28	2.50±1.82	0.0356	2.71±2.28	2.41±1.86	0.0845
Paired-T test, n = 40						

Table 2

Study Type	A1			A2		
Current Direction	Right hand ↓ Left hand	Left hand ↓ Right hand	P value	Right hand ↓ Left hand	Left hand ↓ Right hand	P value
Mean Conductance (μA)	2.89±2.28	2.71±2.28	0.000109	2.50±1.82	2.41±1.86	0.0176
Paired-T test, n = 40						

Table 3

Study Type	B1	B2	B3	P value	Turkey's test
Current Direction	Right hand → Left hand				
Mean Conductance (μA)	3.63±1.62	1.74±0.94	1.62±0.84	0.0001	B1>B2 B1>B3
One-way repeat measure ANOVA test, n = 40.					

Table 4

Study Type	B1	B2	B3	P value	Turkey's test
Current Direction	Left hand → Right hand				
Mean Conductance (μA)	3.46±1.59	1.70±0.91	1.57±0.83	0.0001	B1>B2 B1>B3
One-way repeat measure ANOVA test, n = 40.					

were taken for different directions of applied voltage. The order of studying A1 and A2 as well as the direction of the voltage used was determined randomly by throwing a coin—a total of 15 times for every study. The same rules were used for group B. However, the number of measurements taken was reduced to 10.

The meridians being measured were stimulated by voltage in one direction, and then in the reverse direction. A rest of 20 seconds between every measurement was used to prevent any influence from one test to another. All measurements for each subject were completed in the same day and over a period of several hours.

Results

Because the meridian conductance is measured using a constant voltage of 1.5 volts, all data are expressed in terms of response current. The data from the A1 and A2 studies were analyzed by a paired-T test, and a type I error P value < 0.05 showed significance [8]. The data from group B were analyzed by a one-way repeat measure ANOVA test [9], and the B1, B2, and B3 studies by a Turkey test [9]. The results are presented in tables 1 through 5.

Discussion

The distances between the bilaterally symmetrical acupoints *Wai-Kuan/Wai-Kuan* and *Ta-Ling/Ta-Ling* are longer than between the asymmetrical pairs *Wai-Kuan/Tien-Ching* and *Ta-Ling/Kung-Tsui* on the skin. On the contrary, the resistances of the symmetrical pairs are smaller than those of the asymmetrical ones, no matter how the direction of the applied voltage is applied. This implies that the symmetric acupoints must have a greater conductance than the asymmetric ones. The distance of separation does not seem to be the factor that reduces their conductance.

From the viewpoint of signal communication, the greater conductance between

Table 5

Study Type	B1			B2			B3		
Current Direction	Right hand ↓ Left hand	Left hand ↓ Right hand	P value	Right hand ↓ Left hand	Left hand ↓ Right hand	P value	Right hand ↓ Left hand	Left hand ↓ Right hand	P value
Mean Conductance (μA)	3.63±1.62	3.46±1.59	0.0001	1.74±0.94	1.70±0.91	0.0434	1.62±0.84	1.57±0.83	0.0007
Paired-T test, n = 40									

the symmetric acupoints is thought to be due to their very similar tissue structures, which carry similar electrical characteristics. Therefore, the better signal communication between bilaterally symmetric acupoints must imply that less energy is consumed because of lower resistance.

"Great Acupuncture," a term used in classical acupuncture theory, is an optional acupuncture skill that uses bilaterally symmetric acupoints to treat patients instead of points on their diseased side, including those expressed in The Yellow Emperor's Canon of Internal Medicine (722-221 B.C.). Such a technique has been long used by traditional Chinese medicine for a long time. However, the basic principle was unknown until the results of this experimental study were obtained. We found that the optional use of Great Acupuncture in clinics is reasonable because of the greater conductance that exists between bilaterally symmetric acupoints.

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References

1. **Nakatani, Yosio:** An aspect of the study of Ryodoraku, *Clinic of Chinese Medicine*, p. 54, 1956.

2. **Niboyet, J.E.H.:** Nouvelles Constations sur les Proprietes des points Chinois, *Bull.Sc. Acupunc.*, 30(7): **1958.**

3. **Zhu Zong-xiang:** Research advances in the electrical specificity of meridians and acupuncture points, *Am. J. Acupuncture*, 9(3): 203-215, 1981.

4. **Podshibiaky, AK:** Variations of electrical potential with respect to internal organs and their relation to "active points" of the skin. *J. Physiol. USSR*, 44: 357, 1955.

5. **Reichmanis, et al.:** Electrical correlates of acupuncture points. *IEEE Trans. Biomed. Eng.*, BME 22: 533, 1975.

6. **Voll R:** N*osodenanwendung in Diagnostik und therapie*. Uelzen, Germany: ML-Verlage, 1977.

7. **Chen KG:** II. Electrical properties of meridians. *IEEE Eng. Med. Biol.*, 15(3): 58-63, 1996.

8. **Stanton G:** *Primer of Biostatistics*, 2nd ed. New York: McGraw-Hill Information Service Company, 1989, pp. 139-161,

9. **Kleinbaum DG, Kupper LL, Muller KE:** *Applied regression analysis and other multivariable methods*, 2nd ed. Boston: Pws-Kent Publishing Company, 1988, pp. 344-379, pp. 411-412.