#### **Basic Study**

# Study of the thermal pain threshold latency of acupoints based on Fei Teng Ba Fa

### 飞腾八法腧穴感热痛阈时间研究

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#### Abstract

**Objective:** By applying moxibustion to the eight confluent points in different periods of time, to observe the changes in thermal pain threshold latency of acupoints based on Fei Teng Ba Fa.

**Methods:** A total of 468 healthy college student volunteers received moxibustion at the eight confluent points in three different periods of time, i.e. Chen (7:00-9:00), Wu (11:00-13:00) and Xu (19:00-21:00). The thermal pain threshold latency was adopted to measure the changes in pain threshold of the eight confluent points under different conditions (different periods of time, different genders, different acupoints and different states of the acupoints) based on Fei Teng Ba Fa.

**Results:** Finally, thirty subjects dropped out and 438 subjects were included. The comparison of thermal pain threshold latencies of the eight confluent points in the same opening or closing state based on Fei Teng Ba Fa: latencies of the closing points and adjunct points were significantly different in different periods of time (P<0.05); the latencies of the males were significantly longer than those of the females (P<0.05); there was no significant difference in the latency between the left and right sides (P<0.05); in the female group, there was a significant difference in the latency between the lower-limb points and the upper-limb points (P<0.05). The comparison of thermal point threshold latencies of the eight confluent points in different opening or closing state: in the period of Wu (11:00-13:00), the latencies of the opening points were significantly longer than those of the closing points and adjunct points (P<0.05); for men, their opening and closing points had significantly longer thermal pain threshold latencies than their adjunct points (P<0.05); despite the gender, the latencies of the upper limb opening and closing points were significantly longer than those of the lower-limb opening points were significantly longer than the latency of the adjunct points (P<0.05); in the female group, the latencies of the lower-limb opening and closing points were significantly longer than the latency of the adjunct points (P<0.05); in the female group, the latencies of the lower-limb opening points were significantly longer than those of the lower-limb opening points were significantly longer than the latency of the adjunct points (P<0.05); in the female group, the latencies of the lower-limb opening points were significantly shorter than those of the lower-limb closing and adjunct points (P<0.05).

**Conclusion:** Based on Fei Teng Ba Fa, the pain thresholds of the eight confluent points vary in different periods of time, gender, acupoint location and opening/closing state, which can be taken as the evidence of making time-based acupuncture-moxibustion prescriptions.

**Keywords:** Moxibustion Therapy; Specificity of Acupoints; Research on Acupoints; Chronomedicine; Fei Teng Ba Fa; Points, Eight Confluent; Pain Threshold; Healthy Volunteers

【摘要】目的:通过不同时辰艾灸八脉交会穴,探析飞腾八法取穴时人体腧穴感热痛阈时间的变化。方法:共468 名健康大学生志愿者,分别于辰时(7:00-9:00点)、午时(11:00-13:00点)和戌时(19:00-21:00点)艾灸八脉交会穴,采 用感热痛阈时间评定在不同时辰、不同性别、不同腧穴部位和不同腧穴状态下飞腾八法按时取穴时八脉交会穴 的痛阈变化。结果:脱落、剔除30人,最终纳入研究者438人。飞腾八法按时取穴时,八脉交会穴在相同开阖状 态下感热痛阈时间比较:不同时辰的闭穴、配穴存在统计学差异(P<0.05);男性痛阈时间显著长于女性(P<0.05); 左侧与右侧无统计学差异(P>0.05);女性的下肢穴位与上肢穴位有统计学差异(P<0.05)。八脉交会穴不同开阖状 态下感热痛阈时间比较:午时开穴的痛阈时间显著长于闭穴和配穴(P<0.05);男性的开穴、闭穴痛阈时间显著长 于配穴(P<0.05);男女上肢的开穴、闭穴痛阈时间均显著长于配穴(P<0.05);女性下肢开穴的痛阈时间显著短于 闭穴和配穴(P<0.05)。结论:飞腾八法取穴时,八脉交会穴的痛阈因时辰、性别、腧穴部位和腧穴开阖状态而异, 可作为按时针灸处方的实验依据。

【关键词】灸法; 穴位特异性; 穴位研究; 时间医学; 飞腾八法; 穴, 八脉交会; 痛阈; 健康志愿者 【中图分类号】R2-03 【文献标志码】A

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Xu Feng's Fei Teng Ba Fa (a point-selection method according to time) directly matches the eight confluent points and eight diagrams with the twelve earthlybranch day periods<sup>[1]</sup>, and is one of the time- based acupuncture-moxibustion methods. The opening and closing states of acupoints reflect the flow and level of the gi and blood in human body. Studies have found that the thermal sensitivity of the opening and closing points varies significantly in time and gender, suggesting that the state of the eight confluent points and the level of gi and blood are influenced by time<sup>[2]</sup>. The opening/closing state of the eight confluent points is closely related to the therapeutic efficacy of acupuncture-moxibustion. Using the eight confluent points based on Fei Teng Ba Fa to treat simple obesity, chloasma, chronic eczema, stiff neck and insomnia all can produce a satisfactory efficacy<sup>[3-7]</sup>. According to the correspondence between human and universe, this study enrolled the second-year and fourth-year undergraduates majored in Chinese medicine from North China University of Science and Technology by adopting a random cluster sampling design. The thermal pain threshold latencies of the eight confluent points were observed during moxibustion to observe how the pain thresholds of the eight confluent points relate to time, gender, acupoints' location and opening/ closing state based on Fei Teng Ba Fa, and to provide evidence of making time-based acupuncturemoxibustion prescriptions.

#### **1** Clinical Materials

#### 1.1 Inclusion criteria

The second-year and fourth-year undergraduates from North China University of Science and Technology who majored in Chinese medicine and healthy; aged between 18 and 25 years; informed consent form obtained.

#### 1.2 Exclusion criteria

With mental disorders or other significant medical conditions so that unable to finish the detection of thermal pain threshold latency; those with an abnormal thermal pain threshold.

#### 1.3 Dropout criteria

Those with poor compliance and withdrew from the trial; those failed to complete the observation.

#### 1.4 Statistical method

The SPSS version 17.0 statistical software was adopted for data analysis. The measurement data were expressed by ( $\overline{x} \pm s$ ). The dependent sample *t*-test and one-way ANOVA were used for inter-group comparisons when the homogeneity of variance was conformed, and the least significant difference (LSD) test was used to process multiple comparisons. When the data were in heterogeneity of variance, Welch test was adopted to analyze inter-group comparisons and Dunnett's T3 was

used for multiple comparisons. *P*<0.05 was taken to indicate a statistical significance.

#### 1.5 General data

From the 14th to 28th of September 2014, a total of 468 healthy college students were selected. After 30 people dropped out, the rest 438 subjects were enrolled to the study. Among them, there were 130 males, whose average age was ( $22.1\pm1.3$ ) years and body mass index (BMI) was averaged at ( $23.03\pm3.42$ ); with regard to the 308 females, their average age was ( $21.2\pm1.4$ ) years and BMI was averaged at ( $20.52\pm3.01$ ). There were significant differences in age and BMI between the males and females (*P*<0.05).

#### 2 Methods

#### 2.1 Materials

Pure moxa sticks (Nanyang Wolong Hanyi Moxa Wool Factory, China); chronograph; and scale.

#### 2.2 Selection of acupoints

The eight confluent points, i.e. Neiguan (PC 6), Gongsun (SP 4), Waiguan (TE 5), Zulinqi (GB 41), Houxi (SI 3), Shenmai (BL 62), Lieque (LU 7) and Zhaohai (KI 6), were located according to the *Nomenclature and Location of Acupuncture Points* (GB/T12346-2006).

#### 2.3 Observation method

Under the controlled conditions, temperature at  $(25\pm2)$  °C and relative humidity at  $(50\pm5)$ %, moxibustion was applied by pointing an ignited moxa stick to the acupoint by 1 cm away respectively in the periods of Chen (7:00-9:00), Wu (11:00-13:00) and Xu (19:00-21:00). The measure started immediately when the moxa stick was at the right place until the receiver felt scorching pain, and this period was taken as the thermal pain threshold latency. Each point was measured 3 times in each of the 3 periods of time at an interval of 1 min to obtain a mean value. The points on the left side were detected first.

#### 2.4 Determination of the earthly-branch day periods

The earthly-branch day periods were determined according to the local apparent solar time (a time system based on the sun's apparent position)<sup>[8-9]</sup>.

Local apparent solar time = Standard Beijing time + 4 min × (Local latitude –  $120^{\circ}$ ) + 9.5 min × Sin{2 × [280° + 0.9856° × (Number of days to January 1 of the same year)]} – 7.7 min × Sin[280° + 0.9856° × (Number of days to January 1 of the same year) + 78°].

#### 3 Results

## **3.1** Thermal pain threshold latencies in different periods of time based on Fei Teng Ba Fa

Based on Fei Teng Ba Fa, the closing points had significantly shorter thermal pain threshold latencies in the period of Wu (11:00-13:00) than in the periods of Chen (7:00-9:00) and Xu (19:00-21:00), (P<0.05); the

adjunct points had significantly longer thermal pain threshold latencies in the period of Chen (7:00-9:00) than in the period of Wu (11:00-13:00), (P<0.05); in the period of Wu (11:00-13:00), the opening points had significantly longer latencies than the closing and adjunct points (P<0.05), (Table 1).

## **3.2** Thermal pain threshold latencies of different genders based on Fei Teng Ba Fa

In the same opening or closing state, the males had significantly longer thermal pain threshold latencies than the females (P<0.05). For men, their opening and closing points had significantly longer thermal pain

threshold latencies than their adjunct points (P<0.05), (Table 2).

## 3.3 Thermal pain threshold latencies of points on different sides based on Fei Teng Ba Fa

In the same gender group and same opening/closing state, there were no significant differences in the thermal pain threshold latencies of the eight confluent points between the left and right sides (P>0.05); in the same gender group, there were no significant differences in the thermal pain threshold latencies among the opening, closing and adjunct points on the same side (P>0.05), (Table 3).

Table 1. Thermal pain threshold latencies in different periods of time based on Fei Teng Ba	Fa ( $\overline{x} \pm s, s$ )
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Period	Opening point	Closing point	Adjunct point	F-value	P-value
Chen (7:00-9:00)	13.99±7.65	14.00±8.66	13.41±6.85	1.968	0.140
Wu (11:00-13:00)	13.95±8.36	13.05±7.03	12.41±7.17	5.709	0.003
Xu (19:00-21:00)	13.13±7.29	13.62±7.72	13.07±7.56	2.196	0.111
F-value	2.421	14.296	3.059		
P-value	0.089	0.000	0.047		

Table 2. Thermal	pain threshold latencies of different genders based on Fei Teng Ba Fa (	$\overline{x}$ ±s, s

Gender	Opening point	Closing point	Adjunct point	<i>F</i> -value	P-value	
Male	15.26±8.45	15.18±8.21	14.27±7.82	3.030	0.048	
Female	13.04±7.38	12.91±7.62	12.45±6.87	2.515	0.081	
<i>t</i> -value	5.308	13.516	4.695			
P-value	0.000	0.000	0.000			

Gender	Location of point	Opening point	Closing point	Adjunct point	F-value	P-value
	Left	15.85±9.34	15.35±8.27	14.40±7.77	2.255	0.106
M-1-	Right	14.67±7.43	15.00±8.13	14.13±7.88	1.441	0.237
Male	<i>t</i> -value	1.618	1.222	0.412		
	<i>P</i> -value	0.106	0.222	0.680		
-	Left	12.86±7.02	12.75±7.57	12.21±6.18	2.280	0.103
F 1	Right	13.24±7.72	13.08±7.66	12.70±7.49	0.911	0.402
Female	<i>t</i> -value	-0.928	-1.895	-1.279		
	P-value	0.353	0.058	0.201		

## 3.4 Thermal pain threshold latencies of the upper-limb and lower-limb points based on Fei Teng Ba Fa

In the female group and same opening/closing state, the eight confluent points of the lower limbs were significantly different from those of the upper limbs in comparing the thermal pain threshold latency (P<0.05); in the male group, the opening and closing points of the upper limbs had significantly longer latencies than the adjunct points (P<0.05); in the female group, the opening points of the upper limbs had significantly longer latencies than the closing and adjunct points (P<0.05), the closing points had markedly longer latencies than the adjunct points (P<0.05), and the lower-limb opening points had significantly shorter latencies than the lower-limb closing and adjunct points (P<0.05), (Table 4).

Gender	Location of point	Opening point	Closing point	Adjunct point	F-value	<i>P</i> -value
Male	Upper limb	$15.91 \pm 8.07$	15.07±8.46	13.74±6.69	6.793	0.001
	Lower limb	$14.81 \pm 8.69$	15.29±7.94	15.02±9.17	0.510	0.601
	<i>t</i> -value	1.494	-0.763	-1.766		
	P-value	0.136	0.446	0.078		
Female	Upper limb	14.22±8.62	12.62±7.66	11.89±5.97	15.062	0.000
	Lower limb	12.22±6.25	13.20±7.56	13.27±7.91	7.659	0.000
	<i>t</i> -value	4.607	-3.401	-3.429		
	P-value	0.000	0.001	0.001		

Table 4. Thermal pain threshold latencies of the upper-limb and lower-limb points based on Fei Teng Ba Fa ( $\overline{x} \pm s$ , s)

#### **4** Discussion

Clinically, Fei Teng Ba Fa uses the eight confluent points to treat diseases when the points are in opening state, by matching Neiguan (PC 6) with Gongsun (SP 4), Waiguan (TE 5) with Zulinqi (GB 41), Houxi (SI 3) with Shenmai (BL 62) and Lieque (LU 7) with Zhaohai (KI 7). This study observed the thermal pain threshold latencies of the eight confluent points when the points were playing different roles based on Fei Teng Ba Fa, i.e. opening, closing and adjunct points. The results showed that the latencies were different upon different periods of time, genders and points when the points were in the same opening or closing state. This is plausibly related to the point specificity. Point is known to have nine features: distant connection, integrity, specificity, bi-direction, stratification, holography, magnification, temporality and dynamic nature. The temporality and dynamic nature highlight a series of dynamic changes of an point in different periods of time following the changes in the function of Zang-fu organs and qi-blood<sup>[10-11]</sup>, and the dynamic changes may be the key factor causing the changes in the thermal pain threshold latencies of the eight confluent points in different periods of time. Pain threshold of human body changes as ageing<sup>[12]</sup>. In the current study, the male students who were older and had higher BMI showed significantly longer thermal pain threshold latencies than the female students when the points were in same opening or closing state (P<0.05), indicating that there is a significant difference in the pain threshold between the males and females. The visceral sensory threshold and pain threshold in women are markedly lower compared with those in men, and females have higher VAS in cutaneous stimuli than males, which is unexplainable from the psychological perspective but is possibly associated with the innate neurosensory system<sup>[13]</sup>. There were no significant differences in the latencies between the points on the left and right sides (P>0.05), further suggesting that the circulations of meridian gi and blood on the two sides are symmetric and points are integral. Significant differences were found in the latencies of the eight confluent points

between the upper limb and lower limb in the female group (P<0.05), which may be related to the different structures and distributions of nerves and vessels in upper and lower limbs as well as the constitution of females, and also implies the notable specificity of points.

Besides, this study also revealed that the eight confluent points of the same gender and body region and in the same period of time had significantly different thermal pain threshold latencies when the points were in different opening or closing state: in the period of Wu (11:00-13:00), the latencies of the opening points were significantly longer than those of the closing and adjunct points (P<0.05); for men, their opening and closing points had significantly longer thermal pain threshold latencies than their adjunct points (P<0.05); despite the gender, the opening and closing points of the upper limb had significantly longer latencies than the adjunct points (P<0.05); in the female group, the eight confluent points of the lower limb in opening state had significantly shorter latencies than the closing and adjunct points (P<0.05). The results all indicated that the opening and closing states of points should be related to the level of gi-blood, because normally capillary loops increase when the point is in opening state and the loops decrease when the point is in closing state<sup>[14]</sup>.

In a word, the thermal pain threshold latencies of points based on Fei Teng Ba Fa are closely related to time, gender, point location and opening/closing state. This study has provided certain experimental evidence for the application of Fei Teng Ba Fa. However, there were some drawbacks to this study. First, the study was based on the apparent solar time. Only three different periods of time were observed, so the complete data of rest earthly-branch day periods the need supplementing. Second, we analyzed the adjunct points independently in this study, but in fact, they are also in closing state. Whether or not this would affect the result remains a question. Third, points have resting state and sensitized state. The sensitized state reflects pathological changes in the body, which is universal, specific and dynamic. Thermal sensitization and pain

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sensitization are common types of the sensitized state of points<sup>[15-16]</sup>. Sensitized points usually react intensively to even a tiny stimulation from the outside and they can trigger the transmission of meridian qi very easily<sup>[17-19]</sup>. Therefore, besides the opening/closing state, the sensitized state of point may also have effect on the thermal pain threshold latency and needs further observation<sup>[20]</sup>.

#### **Conflict of Interest**

The authors declared that there was no potential conflict of interest in this article.

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#### **Statement of Informed Consent**

Informed consent was obtained from all individual participants included in this study.

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