

Monitoring effects of acupressure, needle and laserneedle stimulation by infrared thermography and laser Doppler flowmetry?

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Abstract

The aim of this study was to evaluate possible effects of temperature or microcirculation changes on the acupoint UB.67 during acupressure, needle or laserneedle stimulation at the acupoint UB.2, as described for acupressure by other authors. We investigated eleven healthy 7.2 years. The measurement equipment \pm SD of 30.0 \pm volunteers with a mean age consisted of non-contact (infrared camera ThermoCAM P640, Flir Systems Inc., Portland, Oregon, USA) and contact (laser Doppler flowmetry and temperature device DRT4 from Moor Instruments Ltd., Millwey, Axminster, U.K.) methods.

The results showed that there were no significant (one-way repeated measures ANOVA) changes during any of the stimulation methods used.

We conclude that stimulation at the acupoint UB.2 does not change temperature or microcirculation at the acupoint UB.67 in healthy volunteers under constant experimental conditions.

Introduction

Meridian theory is associated with traditional Chinese medicine (TCM) for thousands of years. Although medical acupuncture has been accepted in many countries, the nature of the meridian system and also several details of the underlying mechanisms of acupuncture have not been fully explained by modern science.

The use and the acceptance of thermal imaging and laser Doppler flowmetry in complementary medicine has been proven recently and is described in review articles [¹,²].

The aim of this article was to investigate possible peripheral effects (temperature and microcirculation) at the acupoint urinary bladder 67 (UB.67; Zhiyin) following different stimulation modalities (acupressure, needle and laserneedle stimulation) of the acupoint urinary bladder 2 (UB.2; Zanzhu). In addition, unilateral stimulation on the right acupoint large intestine 4 (LI.4; Hegu) was performed within a separate session at the same eleven healthy volunteers.

Methods

Participants

The eleven healthy volunteers (mean age SD: 30.0 7.2 years; range 28 – 48 years; 7 female, 4 male) agreed to participate in the study and gave written informed consent. The experiments were approved by the Ethic committee of the Medical University of Graz. All participants did not receive any treatment for 24 hours before measuring body temperature and microcirculation.

Experimental Devices

The infrared thermal imaging device used in this study was a ThermoCAM P640 (Flir Systems Inc., Portland, Oregon, USA) with optics of 24° x 18°/0.3 m. The equipment

operates at wavelengths ranging from 7.5 – 13 μm and temperature ranging from $-40\text{ }^{\circ}\text{C}$ to $+500\text{ }^{\circ}\text{C}$ with a sensitivity of $0.06\text{ }^{\circ}\text{C}$ at $30\text{ }^{\circ}\text{C}$ and 30 Hz image frequency.

In addition to thermal imaging, the temperature and the microcirculatory parameter Flux (equal to the product of the average speed and concentration of moving red blood cells in the tissue sample volume) at the acupoints were registered as comparative measurements in a different session using a laser Doppler flowmetry device (DRT4) from Moor Instruments Ltd. (Millwey, Axminster, U.K.). Laser wavelength was 780 nm , whereby the raw signal was filtered with a digital filter from 20 Hz to 22.5 kHz . Probe (diameter 8 mm , length 7 mm) output was defined with 1 mW . The temperature unit ($5 - 50\text{ }^{\circ}\text{C}$) had a resolution of $0.2\text{ }^{\circ}\text{C}$. The experimental equipment is shown in Figure 1.

Figure 1: Multiparametric measurements (temperature and microcirculation) with non contact (left) and contact (right) methods at the Medical University of Graz.



Experimental Procedures

For the measurements the healthy volunteers lay down in the laboratory (temperature $22 - 23\text{ }^{\circ}\text{C}$), shielded from outdoor heat for approximately 10 minutes to allow the skin temperature to adjust to room temperature.

The following acupoint was stimulated on the right side:

UB.2 Zanzhu [3]

Location: On the medial end of the eyebrow, directly above the inner canthus of the

eye.

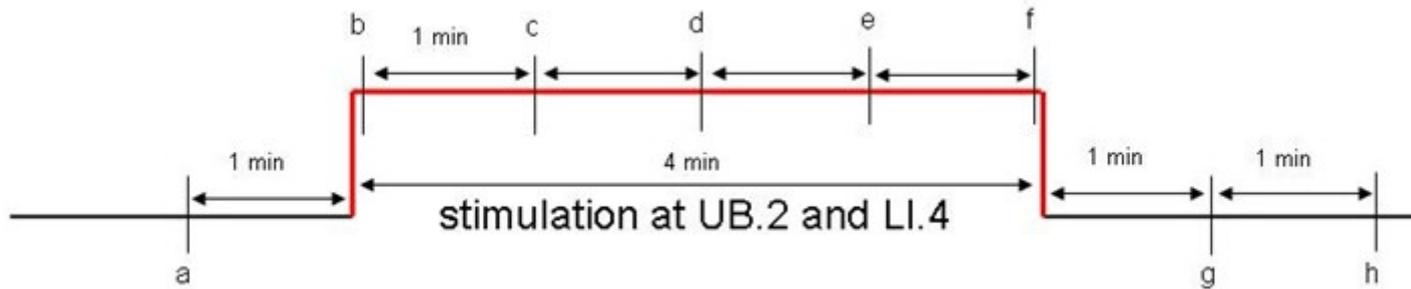
Indications: Eye disorders, frontal sinusitis, rhinitis, frontal headache, migraine.

Three stimulation methods (Fig. 2) were used in different sessions: acupressure, manual needle acupuncture and laserneedle acupuncture. The stimulation procedure and the measuring profile are shown in Figure 3.

Figure 2: Different stimulation methods (a ... acupressure at UB.2, b ... needle acupuncture at UB.2, c ... laserneedle acupuncture at UB.2 and d ... laserneedle acupuncture at LI.4) in the same healthy volunteer.



Figure 3: Measurement profile and measurement times (a – h).



To assess the reliability and validity of acupressure and manual needle acupuncture, pressure on the acupoints and the control point was applied by the same Chinese medical doctor experienced in TCM (L.W., MD). The thumb pressure was estimated to be about 3×10^5 Pa (mean force measured ~ 30 N / 1 cm^2 ; Pascal (Pa) = N/m^2 ; $30/0.0001=3 \times 10^5$) [4]. Total duration of acupressure was 4 min.

Manual needle acupuncture was performed using sterile single use needles 0.30 x 30 mm (Huan Qiu; Suzhou, China). After local disinfection of the skin the needling method was perpendicular (0.5 – 0.8 cun) [3]. Stimulation for a duration of 20 sec in intervals of 1 minute consisted of a combination of rotating and thrusting movements using a special manual acupuncture stimulation technique (sedation method). The needle was removed after 4 minutes (comp. Fig. 3).

Laserneedle acupuncture was performed using a method for optical stimulation. This method was reported by our research group in the scientific literature for the first time [5,6]. The laser used in this study emits red light in continuous-wave mode with an output power of 30 – 40 mW, which results in an energy density of about $0.9 \text{ kJ}/\text{cm}^2$ at the acupuncture point during a stimulation time of 4 min [5,6].

In addition, within a separate session control stimulation was performed using laserneedles at the acupoint large intestine 4:

LI.4 Hegu

Location: There are three possible ways of locating this important point [3]:

1. At the highest point of the m. adductor pollicis with the thumb and index finger adducted. This method is the one most often used.
2. At the midpoint of the line bisecting the angle between the first and second metacarpal bones when the thumb is fully extended.
3. Same level on the radial side of the second metacarpal bone, above the first m. interosseus. This location is different from the first and second and is often used for acupuncture anesthesia.

Indications: LI.4 Hegu is the most important analgesic point. Painful conditions: stimulation of this point relieves pain in all parts of the body. Treatment of disorders of the head area, especially of the face, the neck, and the teeth. Common cold, sweating, fever, abdominal pain, analgesia for childbirth. The specific effect on the head, especially in headache has been verified by clinical research. Needling and

stimulation of this point, owing to its good analgesic effect, is always indicated in all forms of pain treatment. LI.4 Hegu is one of the most frequently used acupuncture points. Traditional application: Promotes the flow of Qi, especially in the upper part of the body, eliminated pathogenic factors, i.e. wind, cold, dampness from the head and lungs [8].

Data recording, thermal imaging and microcirculation monitoring was performed at the acupoint urinary bladder 67 (UB.67):

UB.67 Zhiyin

Location: On the lateral side of the little toe, about 2 mm proximal to the nail corner [8].

Indications: As Jing well point, for acute emergencies. Specifically indicated for breech position of the fetus during pregnancy, promotion of labor and analgesia in childbirth.

Statistical Analysis

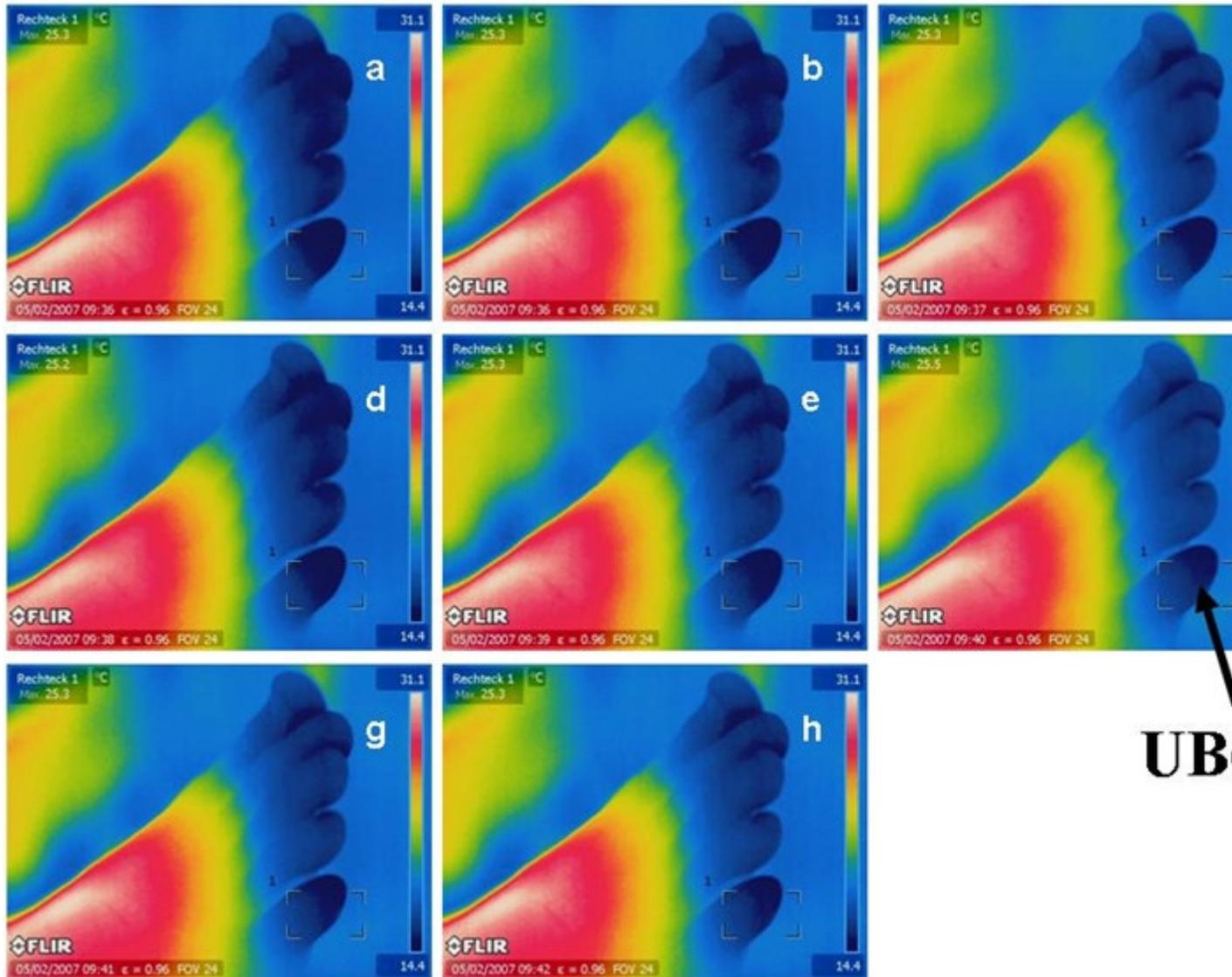
Data were analyzed using SigmaStat (Jandel Scientific Corp., Erkrath, Germany) software. Analysis of variance (one-way repeated measures ANOVA) was used. The results were graphically presented as box plots. Changes were considered significant at a p-value < 0.05.

Results

The thermal images of the right foot of a healthy volunteer before, during and after acupressure stimulation at the acupoint UB.2 are demonstrated in Figure 3.

Figure 4: Typical example of thermal images of the foot. The region of interest (ROI) including the localisation of the acupoint UB.67 is marked rectangular.

Measurement times (a – h) compare Fig. 3.



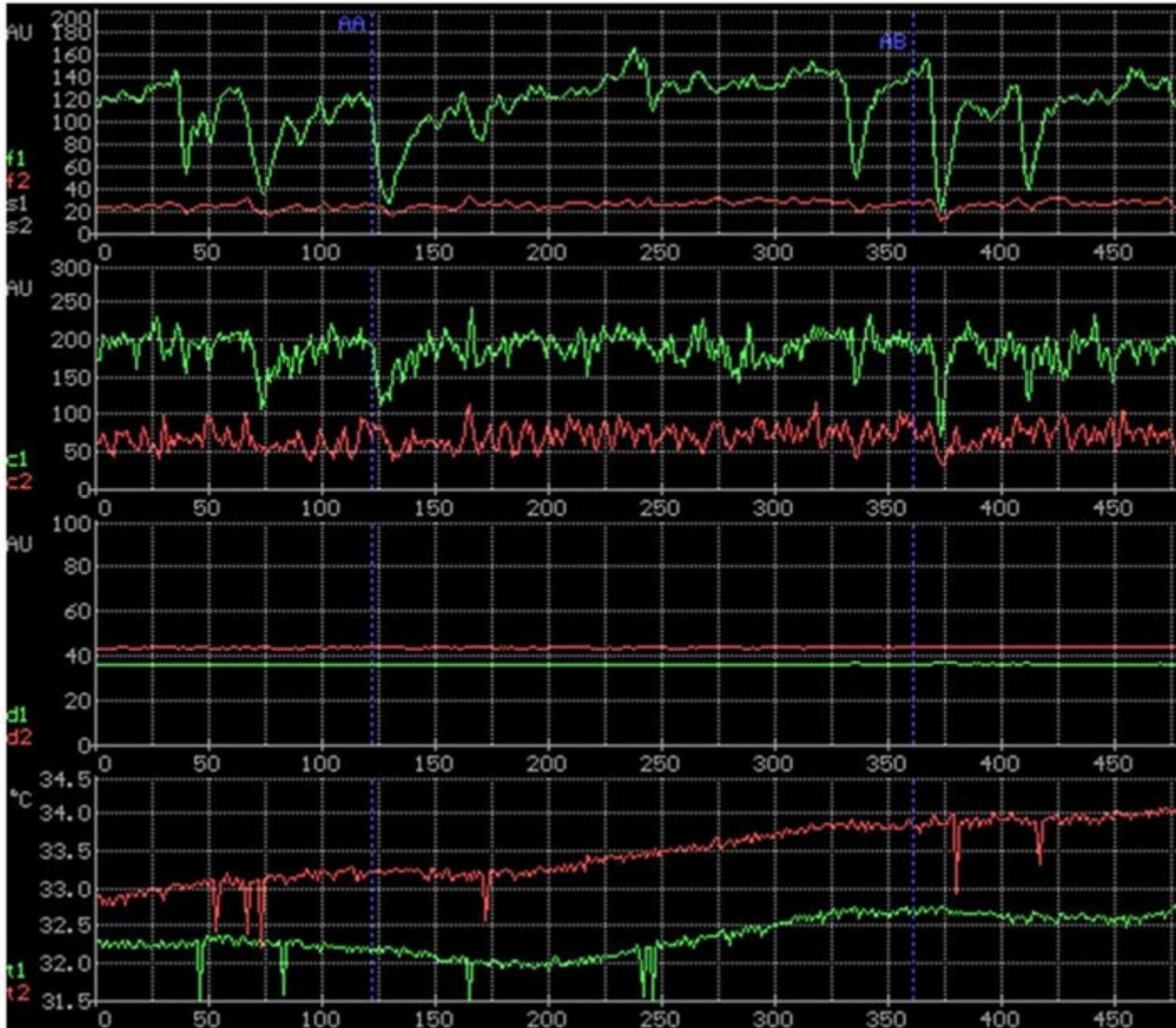
UB

No significant temperature changes were found in the ROI.

Figure 5 shows microcirculatory parameters before, during and after manual needling and stimulation of the acupoint UB.2. Note the increase in temperature in this special person is from the same amount in the acupoint UB.67 as well as in the control point (Fig. 5, bottom).

Figure 5: Microcirculation monitoring in a 29-year-old male healthy volunteer during needle acupuncture at UB.2. From top to bottom: Flux, concentration, backscattered light and temperature. Green: UB.67; red: control point

(localisation compare Fig. 1, middle panel).



The total results of the temperature and flux measurement are shown in Figures 6 and 7. No significant changes were found.

Figure 6: Temperature (T1) at acupoint UB.67 (left) and at the control point (right; T2) during different stimulation modalities (from top to bottom: acupressure, manual needle acupuncture, laserneedle acupuncture at UB.2

and laserneedle acupuncture at LI.4).

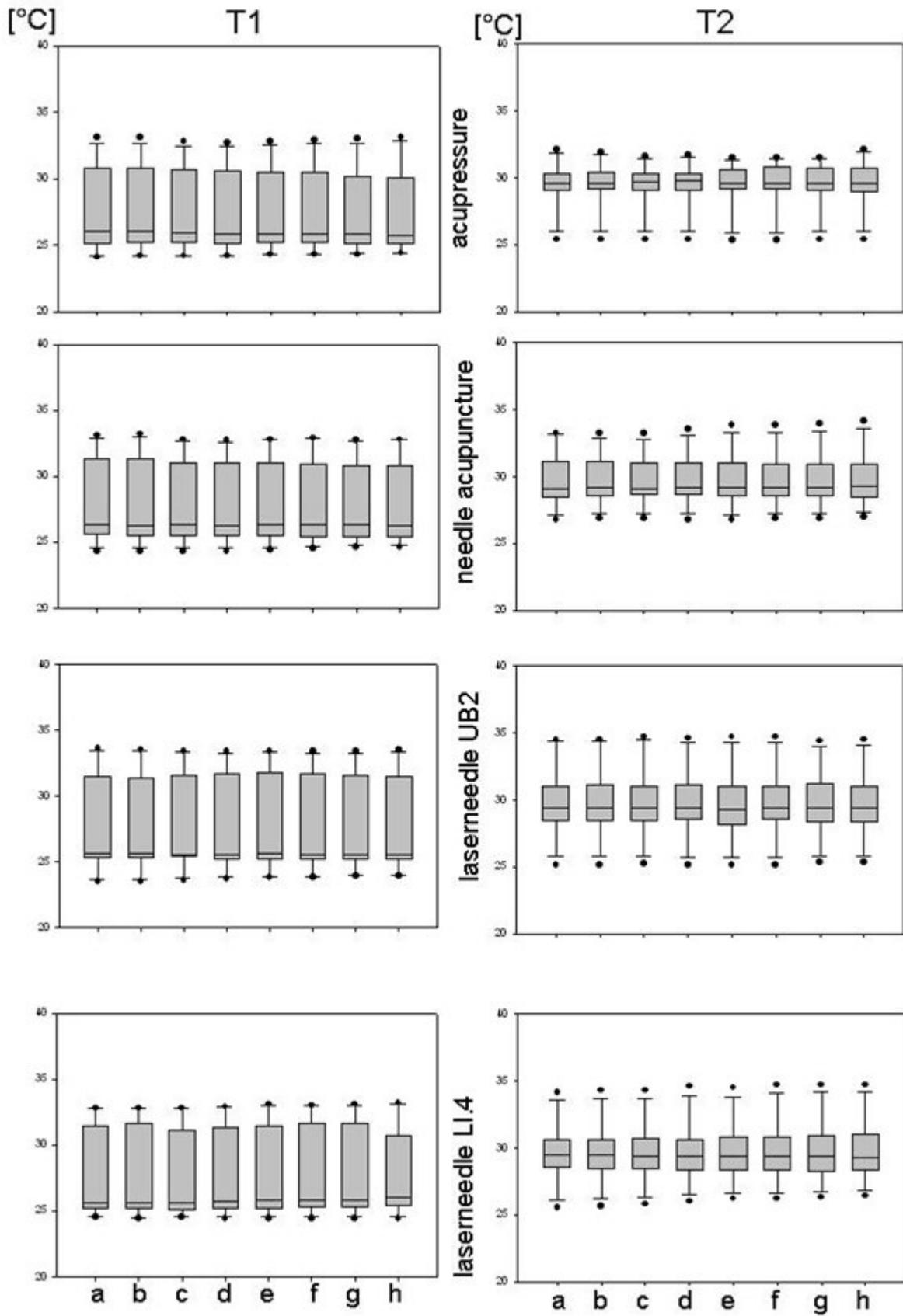
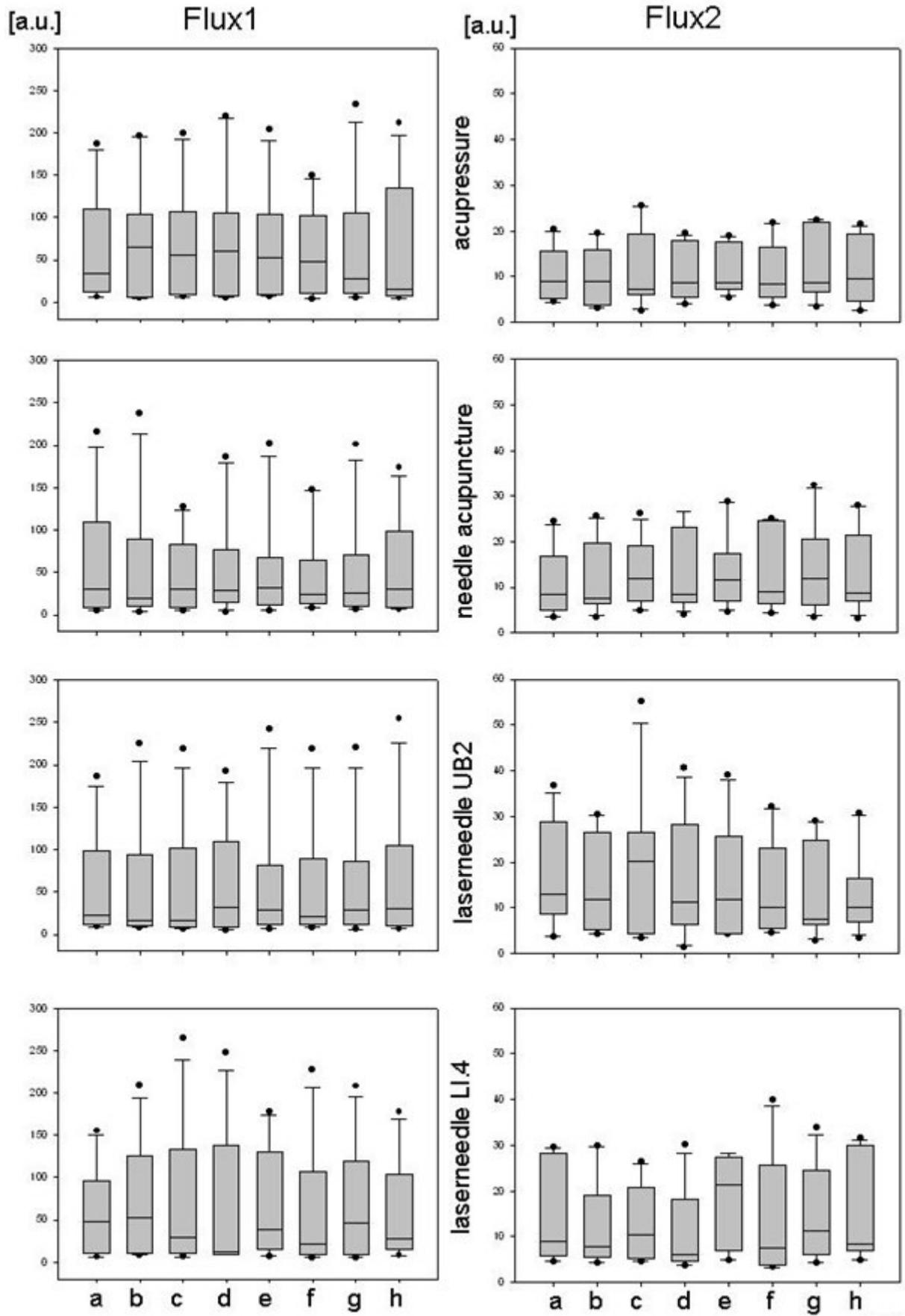


Figure 7: Flux at acupoint UB.67 (left; Flux1) and at the control point (right; Flux2) during different stimulation modalities (from top to bottom: acupressure, manual needle acupuncture, laserneedle acupuncture at UB.2)

and laserneedle acupuncture at LI.4).



Discussion

Although the underlying mechanisms of acupuncture are not fully understood, it is an important component of TCM and widely used for many disorders. There is evidence that acupuncture has specific effects in the brain and the periphery [1,2,7,8,9]. Based on this understanding, the phenomenon that acupuncture or acupressure can change local skin temperature seems to be important.

In the last years, studies at the University of Paris have revealed that under acupressure stimulation in twelve healthy volunteers (20 – 56 years) at the acupoint UB.2, the temperature surrounding the point UB.67 increases significantly within a time period of 4 minutes [10,11]. The authors described that the acupressure stimulus was a 2-minute modulated finger pressure on the acupoint UB.2. It has been concluded that unknown neurovascular effects of the organism may explain the high-speed thermal activity on the dorsum foot point UB.67 [11]. The mechanism is unknown but measurable [11]. The author and the 13 co-authors of the two publications [10,11] used an experimental special adapted non-contact measuring method (infrared thermography). As a stimulation method only acupressure was performed. In our present study we also used a non-contact infrared camera, and in addition in separate sessions contact methods for estimating temperature and microcirculation parameters. Besides acupressure we also used needle and laserneedle stimulation on both the acupoint UB.2 or on the acupoint LI.4. In all of the stimulation methods used we found insignificant changes in temperature or microcirculation on the acupoint UB.67.

In this context it should be mentioned that reports exist in scientific literature describing that temperature increases at special acupoints were found after weight reduction [12]. These authors also stated that further studies are necessary in order to understand the relationship between the temperature at acupuncture points and weight reduction.

In conclusion, in our study neither acupuncture nor acupressure nor laserneedle acupuncture at the acupoint UB.2 led to a significant change in temperature or microcirculation recorded with non-contact and contact methods at the acupoint UB.67, as described by other authors.

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