# THE EFFECT OF ACUPUNCTURE ON THE TEMPERATURE OF THE OCULAR SURFACE IN CONJUNCTIVITIS SICCA MEASURED BY NON-CONTACT THERMOGRAPHY: PRELIMINARY RESULTS

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## 1. INTRODUCTION

In keratoconjunctivitis sicca (KCS), temperature at the ocular surface is elevated.[1,2] External irritations such as local circulation, inflammation, lid pressure, quantity of tear fluid and sympathetic nervous disorders affect this temperature. Pain and anxiety elevate heat sensation, which intensifies the discomfort.[3] Acupuncture, an ancient method with stimulating effects on the nervous system,[4,5] can alleviate these complaints and psychic disorders as well as produce changes in body temperature.[6] The inflammation of KCS is accompanied by discomfort and elevated tension levels.[7] Acupuncture has shown positive results in treating KCS;[8-10] therefore, we looked for a possible etiology to that effect. Psychic tension is elevated in KCS patients compared to healthy controls, and acupuncture reduced this effect.[11] In this study we investigated the influence of acupuncture on ocular surface temperature by directly influencing tear production or irritating the sympathethic system.

## 2. METHODS

In a prospective non-randomized study, periorbital temperature was measured by a non-contact infrared thermometer (THI 500 TASCO, Japan) before and after each

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acupuncture session. Ophthalmological parameters were assessed by Schirmer test (II, modification.Henderson[12]), breakup time of the tear film (BUT), lipid layer thickness (LLT), subjective comfort and drop frequency of artificial tears. Patients had a history of KCS for more than 1 year, and informed consent was obtained. Patients with acute pathology, any other physiotherapy and previous acupuncture treatment were excluded.

After slit lamp examination we observed Schirmer test, BUT, LLT, subjective comfort and drop frequency of artificial tears before and after each treatment. After an adaptation time of 30 min all measurements were made under the same conditions, in a supine position. Points were measured at the center of the cornea, the glabella and both hands and feet, since these points are especially sensitive according to the theory of traditional Chinese medicine (TCM; ). Sterile single needles were used and acupuncture was performed for 30 min once a week over 10 weeks. Acupuncture was done at points according to the empiric influence of the eye according to TCM "YinTang, HeGu," local points and points at the ear (Eye 24). The technique is very slight and any painful sensation was avoided. One week after acupuncture, the final measurements were taken, including ophthalmological observation, subjective comfort and temperature changes. Levels of significance were determined by the two-tailed t-test.

In a preliminary observation, the adaptation time of temperature took longer in air-conditioned rooms of the university hospital (more than 1 h) than in rooms without air conditioning. Therefore, all measurements were performed in another hospital without air conditioning.

## 3. RESULTS

A total of 21 patients (7 men, 14 women) were included. The age range was 21–66 years (average: 53.4 years). The mean corneal temperature decreased by 0.44°C (–0.14 to –0.98°C), and a significant difference ($P < 0.05$) between both eyes occurred after each session and between the first and last session (Fig. 1). No significant difference existed in any measurement from the last acupuncture session to the final observations, one week later. Changes in temperature of body points were not statistically significant ($P > 0.05$), although most patients described a warm sensation in the limbs and body after therapy.

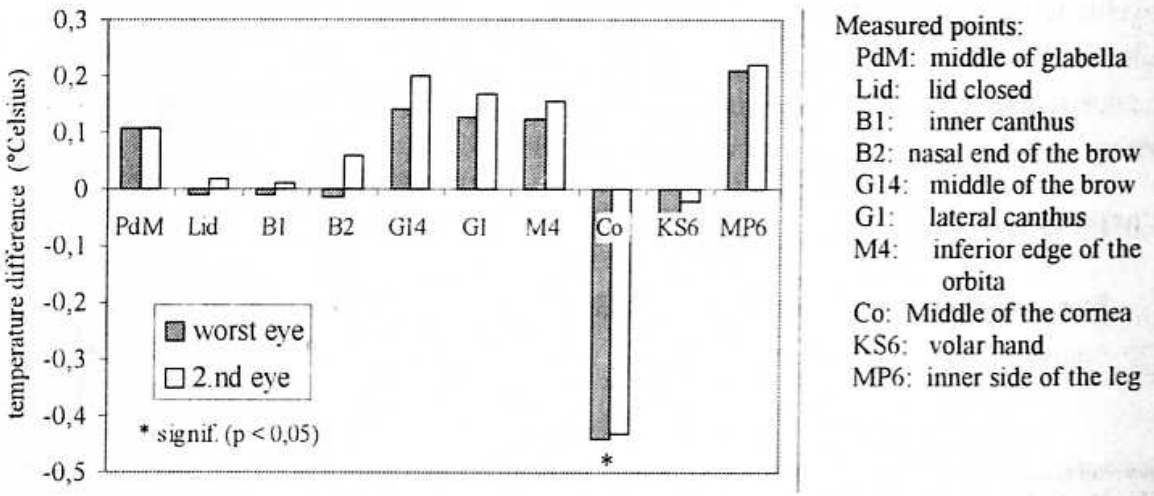


**Figure 1.** Surface ocular temperature changes with acupuncture.

Regarding ophthalmological parameters, an improvement occurred in Schirmer test (+1.7 mm average), but without a significant difference. However, we observed statistical increased changes ($P < 0.01$) in BUT (3-sec mean) and LLT ($P < 0.04$). The artificial tear usage decreased by 0 to 8 drops/day (3.1 drops/day mean, $P < 0.0014$). Although conditions for relaxation were optimized, the effect on body temperature was small.

## 4. DISCUSSION

Inflammation, circulation and lid movement by pressure of the lid margin at the ocular surface influence ocular surface temperature. Dryness and stress of the tissue elevate it but the tear fluid has a cooling effect. The sympathetic nervous system also has an influence by inhibiting tear secretion (by blocking the parasympathetic innervated accessory lacrimal glands) and blinking frequency as well as elevating the pressure of the lid margin. Pain and anxiety influence the sympathetic system and the feeling of heat, therefore reinforcing the sensation of discomfort.[3] The alteration of temperature by the sympathetic system was shown by the cutaneous application of histamine where there was an increased temperature in the limb.[12] Pain influences temperature as observed in carpal tunnel syndrome,[13] and measurement of temperature served as an examination parameter of circulation in Raynaud syndrome to examine the influence of medications (prostaglandin).[14] The temperature of the ocular surface has been measured with the non-contact thermometer like that used in our study to display fluctuations in corneal temperature with smaller k-values,[1,2] the steepness of corneal temperature change. The larger k-value, the quicker the temperature changes, dependent on the decrease of evaporation. However, measurement of temperature at the ocular surface is difficult, especially in conjunctivitis sicca, since differences occur between the limbus and center of the cornea, which is in turn influenced by blinking, the tear film, circulation possible feedback reactions.[15]

Temperature plays an important role in TCM. A subjective feeling of temperature exists, which may be influenced by many diseases. Temperature also has a special function in different treatment modalities. Both are discussed in the description of the eight principles of TCM.[6] Acupuncture has an empiric effect on the nervous system,[4,5] and the aim is to regulate the subjective complaints and psychic disorders caused by the dysfunctions. TCM describes the relationship between body temperature and psychic disorders and its therapy.[6] In the last century, scientific research on acupuncture has shown an elevation of the neurotransmitters (e.g., endorphines) in nerve endings in the spinal root and within the midbrain[16] and of skin temperature, and a decrease of autonomous nervous system tension.[4,17] Acupuncture was effective in treating dry eye syndrome in the first studies.[8–10] Because of the high psychic tension in KCS, described by Erb,[7] we observed the influence of acupuncture on tension, which could be reduced.[11]

Our findings suggest acupuncture affects the temperature of the pre-corneal tear film. Although the mechanism is not clear, we postulate that improvement of the mucus and

lipid layer leads to a decreased in friction of the lid. Decreasing psychic and sympathetic tension and influencing blinking disorders may be other factors.

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