



Palmar and dorsal hand skin thermal response to LED irradiation

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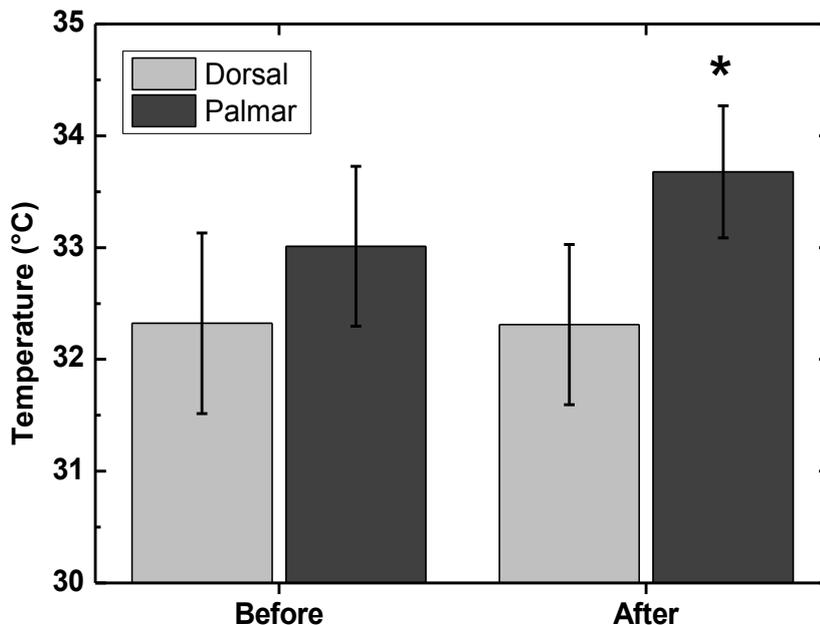
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Background, Motivation and Objective. Changes in skin temperature can be evaluated with infrared thermography, which is a non-contact technique that has been widely used in medical studies. Thermography is useful when complementing the diagnosis and performing the monitoring of body conditions related to hands, as well as assessing their treatment [1]. Recent study showed a strong correlation between the dorsal and palmar temperatures during a cold stress test [2]. Light Emitting Diode (LED) is a device commonly used in practical clinical for various purposes, included dermatology [3], in this way are still very few studies focused on the analysis of hand skin thermal response when irradiated by LED's. Other study indicates an improved microcirculation by increased cutaneous thigh temperature during an exercise with LED irradiation [4]. The aim of this pilot study was to determine behind the infrared thermography the simple thermal response of palmar and dorsal hand skin provoked by LED.

Methods. The study was approved by the Committee on Ethics in Research at Universidade Anhembi Morumbi (process 2.758.904; CAAE 92942618.7.0000.5492). An informed written consent was completed by all 9 participants. It was evaluated 9 hands (right side), dorsal and palmar hand skin, of healthy subjects (male, age 40 ± 13.2 years) submitting to continuous light irradiation from one LED module (LSMCC-R4X3-LP, Super Bright LEDs Inc., MO, USA). This module contain 4 SMD LEDs, 38.5x38.5mm size, 630nm red wavelength, 0.06W total optical power and a 24.8°C of typical module temperature. During thermal imaging acquisition, the right hand of each subject was positioned with the dorsal side to the camera front while palmar side was exposed for 3 min to continuous LED radiation and contrariwise. One spacer of 10mm was used between LED module and irradiated skin. Before the experiments each participant rested for at least 15min. to acclimatize to the temperature room. No interventions were performed during infrared imaging and the participants were instructed not to move your hand during the measurements. Thermal images were performed using a high-sensitive thermography infrared camera (650sc, FLIR Systems Inc., Sweden). The camera was fixed to a tripod in a standardized distance to the hand of 55cm. The camera settings were adjustments considering this distance, emissive factor of the human skin equal to 0.98 and automatic time captured images every 15s, totalizing 12 measurements on each hand position. All thermography images were captured between 10h and 12h with room temperature at 25°C and 50% of humidity. After each participant measurement the LED was turned off for 2min in order to reach the typical temperature. The images were analyzed using a software package FLIR Tools (v. 6.0, FLIR Systems Inc., Sweden) and collected temperature data (spot center, mean and maximum) was made using a box measurement camera tool determined by 112x104 pixels. The data analysis was conducted with Origin (v. 8.5, OriginLab Corp., MA, USA) to calculate mean, standard deviation and statistically significance ($p < 0.01$) using *t*-Test.

Results. The Figure 1 shows the mean palmar and dorsal right hand skin temperature ($^{\circ}\text{C}$) before and after LED irradiation. The palmar temperature was measured with LED irradiating the dorsal side and contrariwise.

Fig. 1. Mean palmar and dorsal hand skin temperature before and after LED irradiation (630nm).



Discussion and Conclusions. Skin temperature can indicate the presence of disease or injury as well as provide information concerning interactions between the human body and the environment changes. The results showed that after dorsal LED irradiation the right hand palm mean temperature increased 0.66°C , however after irradiation of palmar side the dorsal mean temperature increased only 0.01°C . The light hand skin absorption presents a strong dependency of the melanin concentration with 500cm^{-1} of absorption coefficient, where the melanin concentration of dorsal region is higher than palmar region mainly because epidermal content [5], explaining the difference of temperature between both sides. Other parameters like skin phototypes, others strongest chromophores and microcirculation local system effects will be considered in a future works.

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