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Short-term effects of laser needle stimulation on the peripheral microcirculation, assessed with laser Doppler spectroscopy and near-infrared spectroscopy

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ABSTRACT Aim: The aim of the present study was to investigate the direct effects of standardized laser needle stimulation via a defined acupuncture point on microvascular blood flow and muscle oxygenation in the human forearm. Background data: It was recently shown that laser stimulation improves tissue blood flow. This is relevant because an adequate blood supply is an important factor in treating pain syndromes.

The Methods: The study was designed as a randomized, double-blind, placebo-controlled study. Thirty-three healthy, non-smoking men were randomly assigned to a control group (n = 15) without laser irradiation and an intervention group (n = 18) for which laser needle irradiation was carried out on the right forearm at acupuncture point Pe6. Non-invasive blood flow measurements (laser Doppler spectroscopy [LDS]) were performed before, during and after the intervention. In addition, the dynamic changes in muscle oxygenation of the m. flexor carpi ulnaris was examined using near-infrared spectroscopy (NIRS).

Results: In repeated measurements, the MANOVA showed a statistically significant interaction between time and group ($p = 0.034$, effect size = 0.39), which indicates that the peripheral blood flow was influenced by the application of the laser needle. In contrast, tissue oxygenation was not affected by the experimental treatment.

Conclusion: It could be shown that the laser needle stimulation can improve the peripheral microcirculation under standardized conditions, while the tissue oxygenation remained unchanged. Further research is required to determine the influence of various parameter settings and radiation treatments on the peripheral microcirculation. In addition, various acupuncture points should be examined in order to assess the clinical effectiveness of laser needle stimulation.

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Immediate effects of monochromatic infrared energy on microcirculation in healthy volunteers

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Objective: The aim of this study was to investigate the influence of monochromatic infrared energy (MIRE) on the microcirculation of the skin surface of the feet in healthy volunteers. Background data: In an animal study, the near-infrared energy was shown to increase microcirculation. In humans, only one case study showed that MIRE increased microcirculation in the skin of the lower limbs.

The Methods: Thirty healthy volunteers were recruited and randomly divided into three groups, both of which received: (1) active MIRE; (2) sham MIRE (placebo group); or (3) heat packs (control group) on the feet. The MIRE device consisted of an array of 60 x 890 nm LEDs attached to flexible pads (3 Ã Â - 7.5 cm). Each diode spot size was 0.2 cm2 and each LED power was 12 mW with a power density of 60 mW / cm2. The arrays were placed in direct contact with the skin for 30 minutes and provided a total fluence of 108 J / cm2 over an area of 22.5 cm2. Capillary blood cell velocity (CBV) and superficial blood flow (flux) of the skin were recorded before and after the procedure.

Results: Significant differences between the three groups were found in both CBV and flux (both p <0.05). Post-hoc comparisons showed that there was a significantly greater increase in both CBV and flow in the active MIRE group than in the placebo and control groups (all p <0.05).

Conclusion: A 30-minute MIRE resulted in a significantly greater increase in CBV and foot flow in the active MIRE group than in the placebo and control groups.

Effects of near-infrared low-level laser irradiation on microcirculation

Maegawa Y, Itoh T, Hosokawa T, Yaegashi K, Nishi M.
Laser Surg Med. 2000; 27: 427-437.

The present study was conducted to investigate the effects of LLLI on microcirculation. We investigated the effects of LLLI on rat mesenteric microcirculation in vivo and on cytosolic calcium concentration ([Ca2 +] i) in rat vascular smooth muscle cells (VSMCs) in vitro. LLLI caused severe dilation in the laser-irradiated arteriole, which led to a marked increase in arteriolar blood flow. The changes were partially attenuated in the initial phase by the superfusion of 15 microM L-NAME, but they were not affected by the local denervation. In addition, LLLI caused a performance-dependent decrease in [Ca2 +] i in VSMCs.

Effects of 780 Nm diode laser radiation on the blood microcirculation
Study on time-dependent T1-illuminated improved magnetic resonance imaging (MRI)

Schaffer M et al.

Six healthy volunteers were irradiated on their right foot piano with 5J / cm2 and a fluence rate of 100 mW / cm2. T1-weighted MRI was used to quantify the time-dependent local accumulation of gadolinium DPTA, which reflects the local blood flow semi-quantitatively. Pictures were taken before and after the laser application. The LLLT resulted in an increase in the signal-to-noise ratio of more than 0.34 (range 0.23-0.63) after radiation according to contrast-enhanced MRI. The increased blood flow provides an explanation for the clinical observation of improved wound healing and reduced pain after LLLT. The effect could complement other therapeutic modalities such as tumor ionizing radiation therapy and local chemotherapy and improve the outcome.

Cerebral vascular effects of non-invasive laser needles, measured with transorbital and transtemporal Doppler sonography

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Laser Med Sci. 2002; 17 (4): 289-95.

Laser needles represent a new non-invasive optical stimulation method, which is described for the first time in this work. We studied 27 healthy volunteers (mean age +/- SD: 25.15 +/- 4.12 years; range: 21-38 years; 14 female, 13 male) in a randomized cross-over study to determine the differences between the To examine laser needle acupuncture and manual needle acupuncture for certain cerebral parameters. The mean blood flow velocity (v (m)) showed specific and significant increases in the ophthalmic artery during laser needle stimulation ($p = 0.01$) and during manual needle stimulation ($p < 0.001$) at very relevant acupuncture points. At the same time, insignificant changes in the v (m) in the middle cerebral artery were found for both acupuncture methods. The eight laser needles used in this study were placed at the end of the optical fibers. Each fiber was connected to a semiconductor laser diode emitting at 685 nm with a primary output power of about 55 mW. Optical stimulation with correctly adjusted laser needles has the advantage that the patient can hardly feel the stimulation and the operator may not know whether the laser needle system is active, so that real double-blind studies in acupuncture research can be carried out.

In an animal study by Kobayashi of the effect of the gaalas laser on blood flow in lobes

was examined using Laser Speckle Flowgraphy (LSF). 40 rats were divided into four groups. Two groups had flaps with a random pattern, two groups had flaps with an axillary pattern with the dominant vessels intact. The flaps were lifted and the peripheral blood flow assessed using SPF. The laser irradiation was performed in two groups, either directly on the dominant vessel or at a point in the distal part of the flap. The blood flow immediately after the irradiation was higher than before the irradiation. On the 5th day there was a clear difference between the irradiated and the non-irradiated flap. The flaps that were irradiated on the dominant vessels had a slightly better result than the irradiated flaps in the studies by Kobayashi M et al. about the diode laser therapy for the blood supply in the rat model. Proc. 2nd Congress World Assn. For Laser Therapy, Kansas City, September 1998; Pp. 70-71.
