BASICS IN LASER THERAPY AND LASER ACUPUNCTURE

Dr. med. vet. Uwe Petermann (DVM)
49326 Melle, Germany
druwepetermannmelle@t-online.de

Summary
The effect of Low Level Laser Therapy (LLLT) is documented by many scientific investigations. Although this therapy is proven as very effective it is not appreciated in American and European universities. In this paper the results of the most important investigations of LLLT are summarized and the finding of its method of action is reported. Also reported are the findings of long-standing personal experience in laser acupuncture is reported. The possibility of useful combination of laser therapy with laser acupuncture is shown in the following fields: COPD (chronic obstructive pulmonary disease) in horses, chronic back pain in horses, infected tendon sheath and joint inflammation in horses, purulent sinusitis in horses and dogs, degenerative joint diseases in horses and dogs, eye conditions in horses, gynaecology and many other fields. In every indication the acupuncture points used most frequently are introduced.

Key words: Low level laser therapy (LLLT), laser acupuncture, veterinary medicine

History
When Shawlow and Townes (1958) published the construction plans for the laser and Maiman (1960) presented the first functional ruby-crystal laser to the scientific community, there was probably no inkling of the enormous range of applications and types that would develop from this invention. Mester was the first scientist who started in the late sixties with studies about laser irradiation in human tissue and showed significant increase in wound healing after LLLT. One can say that he is the father of LLLT.

Areas of laser application in man and animals
Today, lasers find an ever increasing new and varied range of applications all over the world. The spectrum extends from soft-lasers, for use in cosmetics, to different lasers that are used in many areas of medicine. So far, the most well-known have been surgical lasers, used for incision and cauterisation in endoscopic surgery and for the treatment of ablatio retinae in the eye. In cosmetic surgery, lasers are used therapeutically for the sclerosing of varicose veins, the removal of birthmarks and brush marks right through to the “vaporisation” of aging skin layers and collagen production in exhausted subcutaneous tissue.

Therapy and acupuncture lasers
This paper, however, will give a report of a completely different medical application of laser devices, so-called “Mid-lasers”. Low level laser therapy (LLLT) involves the local treatment of various tissues with so-called therapeutic lasers. These lasers are diode lasers with the great advantage of being very compact. The laser diodes are scarcely bigger than a match-head, so that the entire apparatus including the battery of a modern therapeutic laser can be housed in a device

the size of a cigar. Thus, whether such a compact laser or a stand-alone device with a laser probe connected via cable is used, is actually a question of personal preference. These devices basically work with wavelengths in the infra-red spectrum (600-900 nm). Two types must be distinguished here. On one hand, there are continuous beam lasers, which continually emit laser light. The output of these devices lies between 30 and 200 mW. On the other hand we have impulse lasers that emit very short pulsed laser beams (200nsec each pulse) but with a very high intensity (90watt pulse peak power). The pulse frequency can be adapted to special resonance frequencies in different types of tissue.

Light emission by continuous-wave- laser

The first type of acupuncture laser is continuous wave lasers (cw-laser), which continually emit laser light (Fig. 1). The output of these devices lies between 30 and 200 mW. The laser light emission can be split into different frequencies to attain optimal resonance in different types of tissue. In continuous wave-laser, the Bahr, Nogier and other individual frequencies are modulated as a sinus wave on the basic laser beam.

Figure 1: Cw-laser with 70mW power and integrated Bahr, Nogier,
Meridian- Frequencies and special laser frequencies for the “Chakra” points

Light emission by impulse-laser

The second type of laser is the pulse laser, with which light pulses of very high intensity (peak pulse power of 30 to 100 Watts) but very short duration (200 nsec) are emitted (Fig. 2). Although the tissue penetration of laser light with these devices is very much higher, the short duration of the light beams means that no thermal or even coagulating effects occur in tissues, even at pulse frequencies of up to 10000 Hz. To this end, primarily the Bahr and Nogier frequency ranges are used.

The Bahr frequencies are: Fr.1 – 599.5Hz; Fr.2 – 1199Hz; Fr.3 – 2398Hz; Fr.4 – 4796Hz; Fr.5 – 9592Hz; Fr.6 – 149.9Hz; Fr.7 – 299.8Hz.

The Nogier Frequencies are: Fr.A´ - 292Hz; Fr.B´ - 584Hz; Fr.C´ - 1168Hz; Fr.D´ - 2336Hz; Fr.E´- 4672Hz; Fr.F´- 9344Hz; Fr.G - 146Hz.

Figure 2: Impulse laser with 90W pulse peak power and integrated Bahr, Nogier, Meridian- Frequencies and special laser frequencies for the "Chakra" points; additionally shown, a laser shower with five 30W impulse laser diodes for area application.

Acupuncture lasers are diode lasers

A big advantage of the diode laser is its high level of efficiency. Whilst the Neodyne-YAG laser achieves 2-5% and the carbon dioxide laser 5-10% efficiency, that means that 90% and more of the energy is wasted in heat and not laser light. In contrast, diode lasers reach a level of efficiency of up to 55%. This also means that no costly cooling system need be installed, which would immediately reduce their ease of handling. It is for this reason that the diode laser has been adapted to form an industry standard device, by means of the optical coupling of hundreds of individual laser diodes. Lasers with an output of 2 kW have been produced, and 6 kW lasers are foreseen.

Function of the diode laser

With a diode laser, all the components can be accommodated in the smallest possible space, a fraction of a cubic millimetre. Semiconductor diodes are designed so that negatively charged, electron-rich and positively charged, low-electron layers are embedded in a crystal matrix. When an electric field is applied across the diode crystal, electrons move from the electron-rich N-layer to the electron-poor P-layer. In the laser active zone, only a few atom layers thick, photons are produced. The resonator is formed from two semiconductor layers which reflect the photons: a thin layer in which every newly produced photon is forced to travel back and forth in phase with the existing photons, between the two mirrored end surfaces of the diode. Only when enough photons are oscillating in phase is their collective energy sufficient to emerge through the front, semi-permeable mirror of the diode as a laser beam.

Results of investigations into the effective mechanisms of the therapeutic laser

Physiological basis of laser effects

Research by Popp which established that bio photons play a fundamental role in cell communication by means of so-called "ultra-weak cell radiation" is one of the most important pieces of primary research into laser effects. This involves coherent light; in other words, laser light. The DNA in the cell nucleus can be established as the source of the radiation. These emissions occur in the infra-red to ultra-violet spectra. It was possible to determine in animal tumours that with increasing malignancy, the tumour cells lose their mutual light contact that is important for controlled cell growth. It is assumed that the coherence of the light emissions is also reduced by other pathological processes, increasing disorder emerges and the resonance necessary for communication is lost. The use of laser treatment may be practical here in order to re-establish order. Warnke has specifically made exploratory studies of the infra-red laser. According to these studies, approximately 70% of the laser energy is reflected from the skin surface; 15-20% of the entrant energy is dissipated and lost by diffusion in the body tissues. Thus only 5-10% of the laser energy is absorbed. Absorption is by means of a so-called "antenna pigment", the flavoprotein-metal-redox system (Fig. 3), which forms an important link in the respiratory chain within the mitochondria. Here, absorbed laser photons are transformed directly into cellular energy. This is particularly beneficial for unhealthy cells and cells in tissue modified by illness, which have a particularly high energy requirement to perform their functions. The laser may play a decisive role by providing the necessary energy. Equally, an intense energy pulse in the nerve cells of the acupuncture points can lead to hyper polarisation and thus to unblocking of irritations; whereby the demonstrable pain reduction can be attributed to the laser. The healing of wounds and repair of damaged ligaments are processes requiring high energy inputs. With laser light, the energy required for the breakdown of waste building blocks and the synthesis of new building blocks for wound closure can be provided more quickly and ligament or wound repair accelerated. Important investigations have been made by the pioneer of LLLT, E. Meister, on this topic, which demonstrated as early as 1969, that the proliferation of collagen threads and a marked increase in cell activity after 1-3 laser irradiation of wounds. The results justify the assumption that even in the area not directly irradiated healing is significantly improved due to the increased diffusion of bioactive substances.

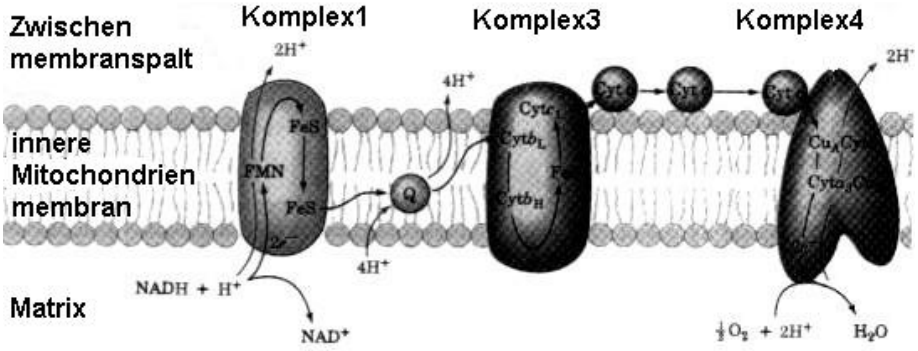

Figure 3: The flavoprotein-metal-redox system in the respiratory chain within the mitochondria.

More than 300 scientific publications on the effects of LLLT

I personally have almost more than 300 scientific publications on the effects of LLLT. I would like to select some investigations as representative of the majority of investigated and confirmed laser therapeutic effects. These established, among other things, the following effects of clearly defined laser irradiation: vasodilatation with mast cell degranulation, activation of macrophages and lysozyme, increased circulation in occlusive arterial diseases, treatment of haemangioma, reduced blood pressure in hypertension, improved capillary circulation in micro-circulatory conditions, applications for wound healing disruptions, analgesia, for spondylosis related pain and after a certain time (several weeks of treatment) for curing spondylosis itself, skin-transplant surgery, for facial paralysis, regeneration of nerve lesions and inhibited nerve functioning. Further impressive research results are available in the areas of rheumatic therapy, lumbago, degenerative conditions of the joints, pain control in invasive procedures such as bone marrow operations, after disc prolapse, dentistry and orthodontics, and orthopaedics, immunology, for low sperm counts, prostate conditions, sports injuries, infected wounds, corneal ulcers and lesions, pain relief in herpes neuralgia (Moore et al.).

A particularly interesting study by T. Karu shows by means of in vivo tests on human capillary blood that laser therapy can considerably increase the clearance of peroxide radicals as measured by chemoluminescence. Interestingly, the maximum increase in clearance coincided at the peak of symptoms (viral infection), it was reduced once again during convalescence, and was no longer observable after recovery. It was also established that the rate of increase was dependent on the pulse frequency of the laser radiation, the wavelength of the laser light used and the irradiation dosage. Several investigations confirm a relation between dosage and effect to the extent that too small irradiation dosages have no positive effect, but then with increasing dosages an increased effect up to a maximum can be achieved. If the dosage is increased further, the stimulating effect is reduced until the previous, non-irradiated condition is reached again. Further studies show that a negative, destructive effect cannot be demonstrated, even with prolonged irradiation (30 minutes).

Despite these extensive studies, the optimal laser power to be used for therapy and the length of treatment can still not be clearly established, since there is naturally a considerable difference between the shaved skin of the laboratory rat and the hairy skin of a dog or horse. On the basis of my own experience, one can presume an optimal effect on surface structures in veterinary medicine for laser output of 50-100 mW (continuous beam) or 50 - 100 W peak pulse power (pulse lasers) over an irradiation time of approx. 20 - 40 sec. For deeper structures, articular cartilage, ligaments, fistulas, sinusitis, the treatment duration must be increased to approximately 2-3 minutes per point.

The foregoing summary of the current state of knowledge in LLL therapy shows unambiguously that the laser may be used effectively for the local treatment of traumatised tissue as well as for acupuncture treatment. Optimal treatment for individual patients thus involves local laser irradiation in combination with appropriate acupuncture points.

Fields of laser acupuncture

Healing of wounds

The most simple but nevertheless very effective indication for local laser therapy is the encouragement of wound healing after trauma or operations; in particular when a rapid resilience of the wound closure should be achieved or the wound is located in an area which is difficult to immobilise, such as joints. Even in many cases of infected wounds, where normally long-term drainage would be required after surgical intervention, per primam healing can often be expected after laser treatment and suture dehiscence avoided. With wounds with larger loss of skin surface or after the removal of larger areas of hyper granulation tissue, wound closure normally occurs very quickly and without complications. With fistula formation and disturbance to the wound demarcation and above all for deep wounds, laser treatment is to be highly recommended. There have even been cases of old scars in which the demarcation had clearly not been closed, opening again after 1-2 laser treatments, cleaning themselves and finally closing up again. Additional recommended acupuncture points: LIV 3, SP 2; and for demarcation: TH 5 and KID 3.

Local inflammation

Traumatic

Local laser treatment proved effective in the following trauma-related inflammatory conditions: acute distortion, capsule tearing, pulled muscles and hematoma. The treatment is also very effective in the treatment of acute and chronic inflammation of the pastern and of acute and chronic tendonitis. A markedly more rapid and complete reduction of accompanying tissue swelling and other symptoms of inflammation such as pain and heat also occurs.

Additional to Low Level Laser Treatment (LLLT) two acupuncture points are very important: SP 2 and GB 41. SP 2 is the Tonifying point of the "building energy channel", Spleen, and so the "Master point of anabolic processes" in the body. GB 41 is the Prostaglandin point of ear acupuncture* and works against inflammation.

Infectious

Laser treatment is also exceptionally useful in infectious local inflammations. In many cases of phlegmonic processes, e.g. after the infection of wounds, in mastitis and even in acute to sub-acute thrombophlebitis, cure can be achieved when previous treatment with antibiotics has proved ineffective. Laser irradiation also has an outstanding effect on the maturation and demarcation of abscesses. This applies, for example, to hoof ulcers or infected inflammations of the hoof dermis which do not mature and diffusely spread into the rest of the hoof dermis and which are normally very difficult to manage. Purulent, acute and chronic sinusitis in dogs and even in horses can usually be effectively treated with laser irradiation, whereby in horses the affected tooth usually does not have to be extracted and the maxillary sinus does not have to be trepanned. Lastly, I would like to cite the highly effective option of treating infected joint and tendon sheath inflammations. At commensurate cost, in most cases excellent treatment success can be expected here.

Acupuncture points one can combine with the LLLT in these cases are: TH 5, SP 4, GB 41 and KI 3. TH 5, is the Thymus point at the ear* and is used in two treatment aspects. On one hand it is used as a confluence point in every treatment of disturbing foci, because it sets tissue demarcation in motion. On the other hand it is used in combination by Midday – Midnight rule,

as a Luo point with its partner Luo point SP 4, the Interferon point*, as "wake up points" for the immune system. GB 41, the Prostaglandin point is used, as the partner Confluence point to TH 5 and works "anti-inflammatory" and "anti- rheumatic" by reduction of Prostaglandin E1. KID 3 is the most important point for using the body's inheritance energy and is called in controlled acupuncture as the master point against "oscillation". Here "oscillation" means every pathologic cell radiation which one finds e.g. in every inflammatory process in the body.

Orthopaedics
Laser treatment is used most frequently for spinal problems, all forms of lameness, acute as well as chronic, in horses and in dogs. But in all conceivable forms of disability with a variety of causes, in most cases laser treatment is strongly indicated. Very often, costly and unreliable operations can thereby be avoided, and even conditions not cured or even made worse by operating can subsequently be alleviated.

Acupuncture points used most often are: LI 4 (Master point against pain), GB 41 (Prostaglandin point, Master point against rheumatic disease), GB 34 (Master point of muscles), BL 11 (Master point of bones), LIV 3 (Source point of the Liver), responsible for the muscle energy , SP 2 (Spleen point of the ear* "Anabolic Master point" and for muscle and tendon repair) and other points, based on location of lameness (e.g. activating the Tendo-Muscular Meridian by treating the Ting point, the Tonification point and the affiliated Reunion point).

Internal diseases
With internal diseases you normally will not find only liver or only lung or only kidney disease as normal medicine mostly tells us. In every illness we find combinations of problems in different channels or, more clearly stated, function circles. But of course we can treat these western internal diseases as acute and chronic lung diseases, e.g., COPD, liver or bladder disease or acute or chronic or interstitial nephritis, etc., by laser acupuncture treatment. As in every especially chronic disease for me it is very important to look for disturbances in the body, like pollutions, and perturberative fields, like scars and affected teeth, in chronic internal illness as well. Helpful standard points for liver problems are the tonifying point LIV 8 and source point LIV 3. This is also the main problem in colic in horses where we can combine SI 3 as master point of spasm and tonifying point of the small intestine and LI 11 the tonifying point of large intestine and LI 4 the master point against pain and the source point. In chronic lung disease like COPD and asthma we find LU 7, the lung point of the ear; KID 7, the kidney point of the ear; Shu point BL 13, and Mu point of the upper part of Triple Heater, CV17 (Triple Heater is the Yang partner of Pericardium); and ST 40, the beta-mimetic point of the ear*. In kidney diseases we can treat as standard the tonifying point KID 7 that is the ear point of Kidney. This point combines the Yin and the Yang energy of the Kidney. When we have the primary problem with the only Yin aspect of the Kidney we can use the source point KID 3 and when the only Yang aspect shall be treated we use GV 3. All these Kidney points are also important when we see a deficiency in eastern Kidney as we know in most chronic illness and tooth problems and neurological disturbances.

Gynaecological disorders and birth problems
Gynaecological disorders are normally connected with Spleen and Kidney meridians. So we can treat points like SP 5, the ovarian ear point*; SP 6, the uterus ear point*; SP 7, the gestagen point

of the ear*. Also important is the Shu point of Spleen BL 20, and the Mu point LIV 13, which is the hypophysis or gonadotropin point of the ear*. With these few points we can treat most gynaecological problems from follicular atresia to behavioural problems in mares that mostly result from ovarian disorders. In birth problems we also have two very simple points that are doing a very good job. These are of course the uterus point* and sometimes in situation of spasms, SI 3. In cases of incorrect fetal positions BL 67 brings the fetus back into the correct position for birth. The last two points are also effective in cases of retained placenta.

Neurology
Principally, disability in dogs due to discopathy or trauma and in horses due to ataxia should be mentioned here. Both illnesses are very often curable, however, often at not inconsiderable cost. Acupuncture points in these cases are very individual. The leading point in every neurological disturbance is KID 4, the luo point of the kidney meridian, which is very good to combine with LI 6 the luo point of the large intestine, by the midday – midnight rule.

Eye conditions
With regard to eye conditions, it is principally treatment-resistant corneal injuries, corneal ulcers, corneal occlusion and also deep eye injuries which may be treated successfully.
Acupuncture points are GB 41, ST 1, TH 23, BL 1 and GB 1.

Local laser treatment as the ideal introduction to acupuncture

If laser treatment of acupuncture points is used to target sympathetic vegetative and humoral control mechanisms, every local laser treatment can be further improved in their effectiveness. Acupuncture may be started relatively easily in the areas listed above, using a rather small number of highly effective acupuncture points. Any acupuncture therapy you can do with needles, you can do with laser in the same way without any traumatic effect and if you want, without touching the patient. The straightforward introduction and the possibility it offers of convincing oneself of the outstanding effectiveness of laser acupuncture in a considerable range of indicated conditions are strong factors motivating towards making the effort of learning more about this area. All colleagues who have taken this first step are astonished again and again by the really significant extension of therapeutic possibilities beyond the known and the hitherto accepted.

*Every body acupuncture point has a corresponding point at the ear. There is no difference, if one treats the ear point e.g. the “Lung point” or the identical body point LU 7. Both points can be treated at the same time to intensify the treatment.

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