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Treatment of leg ulcers with polarised light*

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Laser beams have earned a firm place in medicine during the second half of this century. Names such as Goldman (USA), in surgery Kaplan (Israel), Jako (USA), Polanyi (USA), in ophthalmology Wolbrasht (USA), in dermatology Parrish (USA) and Dougherty (USA), and in cell biology and general surgery Burns (USA) are associated with their introduction into the individual specialties named.

Since 1967, experimental work has also been concerned with the irradiation of wound surfaces, and an effect promoting wound healing has been demonstrated, particularly in poorly-healing wounds and ulcers, which was first globally described as biostimulation. A comprehensive literature has built up on treatment with laser light and its promoting effect on the healing process.

Because the theories on the biostimulating action of lasers were initially contradictory, and a continuously-operating laser with the power and beam diameter required is complicated, costly and not without risk, the treatment was unable to get established to the extent its efficacy would have deserved.

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This changed when the characteristics of laser light were more precisely examined:

Monochromaticism (light of equal wavelength)
Coherence (oscillation of equal amplitude)
Capacity to produce extremely high-energy beams
Polarisation (oscillation in a single plane).

It was the achievement of Mester's research group (1978) to discover that irradiation with linear polarised incoherent light produced results almost identical to those of treatment with a helium laser, which was also linear polarised.

Clinical tests further showed that monochromaticism (light of the same wavelength) and oscillation of equal amplitude were not of importance, as specific laser characteristics, for the healing effect. By contrast, molecules of liquid crystals exposed to laser light were reorganised by the linear polarised light.

In the hypothesis put forward by the Hungarian research group of Kertesz, Fenyö, Mester and Bathory in 1982, liquid crystals were proposed as a model for the cell membrane. The biologically active proteins are embedded in the lipoidal double-layer of the cell membrane. The effect of polarised light on the lipoidal double-layer of the membrane is seen in structural changes (such as ordered distribution, redistribution of the surface

charge, and protein/lipoid binding). The strength of the electromagnetic field in linear polarised light changes the structure of the lipoidal double layer of the cell membrane as it rearranges the polar terminals of the lipoids. Comparative studies of wound healing in rats proved clearly favourable to polarised compared with non-polarised light (Barabas).

On the basis of these investigations and considerations, the research group of Kertesz, Szegö, Rosza and Fenyö constructed a light source which simplified the irradiation of poorly-healing wounds, reduced the risk and was also more economically constructed. This emits a yellow light with wavelengths from 400 to 3000 nm, and thus has no UV component. The penetration depth amounts to about 2.4 cm, and the power to 0.163 joules/sec, equivalent to 4.8 joules in a 30 sec exposure.

Since 1982 several research groups in Hungary, Sweden and the Federal Republic of Germany have participated in testing this method of treatment. While searching for possible additional ways of treating problem ulcers, I encountered the first successful reports in 1983, in which therapeutic success was documented in the surgery of delayed wound healing, secondary healing, diabetic gangrene, burns, skin grafts, fistula therapy , and even in leg and decubital ulcers.

Contact was then made with Stäcker in Bremerhaven, who had in the meanwhile been able to report on experience

of treating 300 patients. At the same international symposium, on 8.10.1984 in Budapest, Andersson (Sweden) convincingly confirmed the efficacy, on the basis of reduction of wound surface in a double-blind trial.

According to the present status of basic research, which has not yet been completed, efficacy rests on the increase of neutrophil granulocytes and enhanced phagocytosis in biopsies removed for comparison before and after treatment. It is thus the simplest form of cellular defence of the organism that is first enhanced. The proportion of lymphocytes and monocytes also rises. The increase in immunoglobulins, particularly IgM and IgG, but also IgA, suggests that the humoral defence mechanism is also activated.

In Hamburg, we have treated 52 patients with leg ulcers at a phlebological/dermatological polyclinic within the past year. Without exception, these were problem patients with post-thrombotic ulcers or ulcerative conditions associated with chronic venous insufficiency and problem organisms such as Pyocyaneus, Proteus, E. coli, and Streptococcus enterogenes. The ulcers had been present for months or years and failed to respond to compression therapy. Even prolonged hospital admissions and attempted grafting had not significantly influenced the course of healing. Ulceration in mixed venous/arterial perfusion disorders, in occlusive arterial disease, after surgery and radiotherapy of malignant tumours, and following

osteomyelitis completed the group of these problem patients.

Healing could be achieved in 26 patients (50%). Thirteen patients (25%) were significantly improved and are still undergoing treatment at present. Among the remaining 13 patients (25%), irradiation with polarised light has so far been without effect, though it is still not possible to say why they have not responded to therapy.

In applying the treatment we proceeded as follows:

Before irradiation, any necrotic tissue present was removed, the wound cleaned, and dabbed dry, since a thickish covering of fluid or secretion is disadvantageous. Then the focused light beam (effective area 2 cm^2) was applied vertically at a distance of 30 cm for 30 sec. With larger wounds, the adjacent field was then irradiated for a further 30 sec, and the treatment continued systematically, always at 30 sec per field, until the whole wound surface had been irradiated. The marginal area was included in this, up to healthy tissue, because most healing proceeds from here. The apparatus contains a timing clock, which gives an acoustic signal at the beginning of treatment and then every 30 sec.

In our experience the treatment should first be given once daily. In 90% of cases this already leads to marked amelioration of pain after a few applications, so that no further analgesics are required. The change in the

clinical picture was so marked that the patients told us, independently of one another, that they would miss the application at week-ends when no irradiation was given. Once pain is relieved and the wound becoming cleaner, we have been able to extend the treatment intervals to 2 days, and sometimes even to 3 days. At the same time, compression therapy was continued in all cases. In contrast to some authors, we have not been able to dispense with local treatment (covering of wounds with antibiotics, ointments, paraffin gauze, or powder). Such attempts proved definitely negative in our patients.

There is still no explanation today why the treatment is not successful in all cases.

Dense scar formation and infiltration are certainly disadvantageous. Fresh fatty tissue can, as Stäcker has indicated, become necrotic.

The results so far obtained are nevertheless so encouraging that they deserve to be confirmed in hospital and out-patient practice. The treatment of leg ulcers with polarised light is certainly no wonder-cure. It cannot replace the classical methods of wound treatment, skin grafting and compression, only complement them, but it has a future.

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