

Improvement of wound healing by water-filtered infrared-A (wIRA) in patients with chronic venous stasis ulcers of the lower legs including evaluation using infrared thermography

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Abstract

Background: Water-filtered infrared-A (wIRA) is a special form of heat radiation with a high tissue-penetration and with a low thermal burden to the surface of the skin. wIRA is able to improve essential and energetically meaningful factors of wound healing by thermal and nonthermal effects. Aim of the study: prospective study (primarily planned randomised, controlled, blinded, de facto with one exception only one cohort possible) using wIRA in the treatment of patients with recalcitrant chronic venous stasis ulcers of the lower legs with thermographic follow-up.

Methods: 10 patients (5 males, 5 females, median age 62 years) with 11 recalcitrant chronic venous stasis ulcers of the lower legs were treated with water-filtered infrared-A and visible light irradiation Hillerød, Denmark (wIRA(+VIS), Hydrosun® radiator type 501, 10 mm water cuvette, water-filtered spectrum 550–1400 nm) or visible light irradiation (VIS; only Johann Wolfgang Goethe possible in one patient). The uncovered wounds of the patients were University, Frankfurt/Main, irradiated two to five times per week for 30 minutes at a standard distance of 25 cm (approximately 140 mW/cm² wIRA and approximately 45 mW/cm² VIS). Treatment continued for a period of up to 2 months (typically until closure or nearly closure of the ulcer). The main variable of interest was “percent change of ulcer size over time” including complete wound closure. Additional variables of interest were thermographic image analysis, patient’s feeling of pain in the wound, amount of pain medication, assessment of the effect of the irradiation (by patient and by clinical investigator), assessment of feeling of the wound area (by patient), assessment of wound healing (by clinical investigator) and assessment of the cosmetic state (by patient and by clinical investigator). For these assessments visual analogue scales (VAS) were used.

Results: The study showed a complete or nearly complete healing of lower leg ulcers in 7 patients and a clear reduction of ulcer size in another 2 of 10 patients, a clear reduction of pain and pain medication consumption (e.g. from 15 to 0 pain tablets per day), and a normalization of the thermographic image (before the beginning of the therapy typically hyperthermic rim of the ulcer with relative hypothermic ulcer base, up to 4.5°C temperature difference). In one patient the therapy of an ulcer of one leg was performed with the fully active radiator

(wIRA(+VIS)), while the therapy of an ulcer of the other leg was made with a control group radiator (only VIS without wIRA), showing a clear difference in favour of the wIRA treatment. All mentioned VAS ratings improved remarkably during the period of irradiation treatment, representing an increased quality of life. Failures of complete or nearly complete wound healing were seen only in patients with arterial insufficiency, in smokers or in patients who did not have venous compression garment therapy.

Discussion and conclusions: wIRA can alleviate pain considerably (with an impressive decrease of the consumption of analgesics) and accelerate wound healing or improve a stagnating wound healing process and diminish an elevated wound exudation and inflammation both in acute and in chronic wounds (in this study shown in chronic venous stasis ulcers of the lower legs) and in problem wounds including infected wounds. In chronic recalcitrant wounds complete healing is achieved, which was not reached before. Other studies have shown that even without a disturbance of wound healing an acute wound healing process can be improved (e.g. reduced pain) by wIRA. wIRA is a contact-free, easily used and pleasantly felt procedure without consumption of material with a good penetration effect, which is similar to solar heat radiation on the surface of the earth in moderate climatic zones. Wound healing and infection defence (e.g. granulocyte function including antibacterial oxygen radical formation of the granulocytes) are critically dependent on a sufficient energy supply (and on sufficient oxygen). The good clinical effect of wIRA on wounds and also on problem wounds and wound infections can be explained by the improvement of both the energy supply and the oxygen supply (e.g. for the granulocyte function). wIRA causes as a thermal effect in the tissue an improvement in three decisive factors: tissue oxygen partial pressure, tissue temperature and tissue blood flow. Besides this non-thermal effects of infrared-A by direct stimulation of cells and cellular structures with reactions of the cells have also been described. It is concluded that wIRA can be used to improve wound healing, to reduce pain, exudation, and inflammation and to increase quality of life.