EFFECT OF NEAR-INFRARED LIGHT IRRADIATION ON WOUND HEALING USING HIGH POWER LIGHT EMITTING DIODES

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INTRODUCTION At the 3rd congress of Japan Society for Laser Medicine¹⁾, we have reported that the irradiation of low-power density Ar laser light (514.5 nm) on experimental wounds and clinical ulcers has an effect to accelerate wound healing^{2,3)}. As a further extension, non-polarized and linearly polarized light from near-infrared light emitting diodes (LED) were irradiated on experimental wounds to examine light character dependence of this effect. The findings will be reported in this paper.

MATERIALS and METHODS Healthy male guinea pigs, initially weighing 200-260g, were used throughout the experiment. Under ether anesthesia, the hair was removed from the back of the animal. Then two round full thickness skin defects, 1 cm in diameter, were made on both sides of the back at about 1 cm away from the spine. One of the wounds were left intact, while the other wound was irradiated by near-infrared non-polarized light or its linearly polarized component every other day. The healing rate of the irradiated wounds was compared with that of the non-irradiated wounds in the same animal. The area of wound was measured each time by taking pictures until the wound healed.

For the near-infrared light source, 3 pieces of light emitting diode (LED:HITACHI model HLP60RG; center wavelength 803 nm, FWHM 30 nm) were used. The output power of each LED was 30 mW, which had a higher output than the usual chip in the market. Fig.1 shows the external view of the instrument with a power source and a handpiece for the irradiation. When the wounds were irradiated by the linearly polarized light, a polarizer

Fig. 1 The instrument for wound healing by near-infrared irradiation using three LEDs.

was fitted on the output surface of the handpiece. As is seen in the figure, this instrument is compact and handy as well as inexpensive. It can be easily operated by conventional AC 100V supply.

An area of 2 cm in diameter was irradiated

by this handpiece, irrespective of the actual area of the wound during the experiment. The power density on the wound surface was estimated to be 17 mW/cm^2 with the irradiation time of 120 sec (total energy density : 2 J/cm^2).

Table 1 Comparison of wound healing effect on experimental wounds using non-polarized and linearly polarized near-infrared light from LED.

Experiment	Character	Cases	Duration of Wound Healing (days)	
			Mean	s.d.
Control		16	17.4	± 2.2
Irradiated	Non-polarization	7	16.0	± 1.3
Non-irradiated		7	17.3	± 2.3
Irradiated	Linearly-polarization	9	14.3	± 1.5
Non-irradiated		9	16.3	± 1.0

RESULTS and DISCUSSIONS Table 1 summarizes the experimental result of the duration of wound healing. Appreciable difference of wound healing could not be detected between the non-polarized light irradiation group and the non-irradiated group. However, in those with the linearly polarized light irradiation, the duration of wound healing became significantly shortened. Hence, we could confirm a qualitative difference of its effect on wound healing between the groups irradiated by the non-polarized light and the linearly polarized light with the same wavelength.

The change of temperature under the skin of irradiated area was measured by a thermistor-type thermometer. It was observed that the temperature changes about 1°C during the irradiation in both cases. Accordingly, no significant relationship was found between the accelerated effect of wound healing and thermal effect of light. Moreover, the transmissivity of light through biological objects was measured. The near-infrared light at 803 nm transmitted about two times better than Ar laser light at 514.5 nm. From these results, it is inferred that the near-infrared light reaches deeper than Ar laser light when it was irradiated on experimental wounds.

References

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