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Faculty of Veterinary Medicine
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Studies on photobiostimulation of soft and hard tissues healing

A thesis presented by

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For Ph.D degree

(Surgery, Anaesthesiology and Radiology)

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**“Studies on photobiostimulation of soft and hard
tissues healing”**

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Abstract

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Name: Hosam El Din Mostafa Mohamed Ahmed

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Title of the thesis: Photobiostimulation of soft and hard tissues healing

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This study was divided into two studies; Experimental animal study carried out on 135 rats and clinical study carried out on 20 dog of different breed, sex, age, and fresh wound site. The experimental study rats were subdivided into soft tissue part (60 rat) and hard tissue part (75). Sixty rats were subjected to circular skin excision and divided into four groups each group contains fifteen rats. Control group was left without any treatment while the Red laser 650nm group, Infrared laser 906nm group, Red LED group was treated by 4-5 J/Cm² on daily basis for 7 sessions. A representing 5 Rats of each group were euthanized at days 3,7,15 post-wounding. Results showed that Red laser was the best tool for soft tissue healing promotion followed by LED. In the hard tissue part, experimental tibial osteotomies fixed with intramedullary pins was biomodulated either by IR laser or red laser. Seventy five rats subjected to tibial diaphysial osteotomies and fixed by intramedullary pins. Rats were divided into 3 groups of twenty five rats each; control group was left without any laser exposure, Infrared laser group treated by infrared laser 1064nm, Red laser group treated by Red laser 650nm. The dose was adjusted to 10 J/Cm² on daily basis for one week. All animals were evaluated by x-ray on weekly basis for one month. Low level laser therapy (LLLT) was effective for the stimulation of bone healing. Clinical fresh skin wounds of 20 dogs of different sex breed, age and site of the wound divided into 4 groups 5 each. The control group, was left without light source treatment. The other groups, were treated by red laser 650nm, red LED 630nm and green laser 532nm. Each dog received 5 J/Cm². Red laser 650nm, red LED 630nm, and green laser 532nm showed promising results.

Key words: Photobiostimulation, Laser, Fracture Healing Biostimulation, wound Healing biostimulation, Fracture healing photostimulation, Low Level Laser Therapy.

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List of Abbreviations

Abbreviation	Meaning
ALP:	Alkaline Phosphatase
Å:	Angstrom = 10^{-10} meter
Ar laser:	Argon laser
ATP:	Adenosine triphosphate
BMD:	Bone mineral density
BMPs:	Bone Morphogenetic proteins
c:	velocity of light
Cm:	centimeter = 10^{-2} meter
Cm ² :	centimeter square = 10^{-4} square meter
CO ₂ Laser:	Carbon dioxide laser (wave length 10600nm)
CW :	Continuous wave Electromagnetic wave of constant amplitude and frequency .
E:	Energy
EDTA:	Ethylene diamine tetraacetic acid
Er:YAG laser:	Erbium-doped yttrium aluminium garnet
FIR :	The Far Infrared Region of the electromagnetic spectrum extending from about 2500 nm to 10600 nm.
GAALAS:	Gallium Aluminum Arsenide

List of Abbreviations

Ga-As:	Gallium Arsenide
He:Ne laser :	Helium Neon laser (wave length 632nm)
IR:	Infrared
J:	Joule
kHz :	Kilo Hertz
LED:	Light Emitting Diode
LILAB:	low-intensity laser-activated biostimulation
LIPUS :	low-intensity pulsed ultrasound
LLLT:	low-level laser (or light) therapy
LPBM :	Photobiomodulation
mW:	milliwatt
NASA :	National Aeronautics and Space Administration
Nd:YAG laser :	Neodymium: Yttrium Aluminum Garnet laser (wave)
NIR :	Near Infra Red Region of the electromagnetic spectrum extending from about 700 nm to 950nm.
nm:	nanometer = 10^{-9} m
PBM:	Photobiomodulation
PDT:	photodynamic therapy
Phi: Φ	beam diameter

List of Abbreviations

PT :	phototherapy
TGF- β_2 :	Tumor Growth Factor β_2
UV:	Ultraviolet
λ :	wave length
μm :	micrometer = 10^{-6} m
ν :	Frequency

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