

## REVIEW ABOUT LOW LEVEL LASER BEAM THERAPY AND WOUND HEALING

Dunnia Abdullah Barakat\*<sup>1</sup> and Ali Abdul-Hussain Ghazzay<sup>2</sup>

<sup>1,2</sup>College of Science - University of Al- Qadisiyah, Iraq.

Article Received on  
21 July 2020,

Revised on 11 August 2020,  
Accepted on 01 Sep. 2020

DOI: 10.20959/wjpr202010-16253

### \*Corresponding Author

**Prof. Dunnia Abdullah  
Barakat**

College of Science -  
University of Al- Qadisiyah,  
Iraq.

[dunnia.Barakat@qu.edu.iq](mailto:dunnia.Barakat@qu.edu.iq),  
[ftum2014@gmail.com](mailto:ftum2014@gmail.com),

### SUMMARY

Healing of injury is one of great problems that humanity has faced. Healing of injury is a series of processes this leads to the occurrence of healing, which takes a different period of relying on the kind and location of the injury in addition to the surrounding conditions<sup>[1]</sup>. In diverse periods and times, There were attempts to accelerate the restoration, of injury healing, where different treatments and drugs was done for this objective<sup>[2]</sup>. This process is a Complicated process, carefully organized physiological restraint to a painful incision. Editing of this coordinated process can consequence in a large wailformation. In some individuals, the abnormal healing process results in excessive scarring that may go beyond the original limits of the wound, leading to a large cosmetic problem.<sup>[3]</sup>

### INTRODUCTION

Injury restoration is a compound and dynamic process of call cellular constructing and textile layers. The human most injury restoration process can be split into three distinguished stages: the inflammatory phase, proliferative phase, and the remodel phase. Within these 3 broad stages is a complicated and coordinated series of events that stimulate chemotaxis, phagocytosis, neo collagenesis, collagen degradation, and collagen remodeling. In addition, angiogenesis, epithelization, and the fabrication of new glycosaminoglycans (GAGs) and proteo glycans are vital to the injury healing milieu. The the climax for these biological procedure results in alternate of natural skin structures with fibroblastic intermediate wail tissue.<sup>[4]</sup>

There are three featured biological stages in injury-healing process of reinstitute cellular installation and tissue layers: inflammation, proliferation, and remodeling or maturation. All

three stages are whole to the completion of the healing method, so they may happen at diverse rates. Wailformation may happen from too fibroblastic proliferation or inappropriate healing and native and systemic agents that impede injury healing. Agents that prevent injury healing can be classify into native which contain dry environment, edema, incontinence, infection, necrosis, and pressure and systemic which include age, body build, chronic diseases, nutritional status, vascular inadequacy, radiation and immunosuppressant therapy.<sup>[5]</sup>

Although diverse division of injury healing have been qualified, the ultimate outcome of any process of healing fixture of a tissue defect. Initial healing, late initial healing, and healing by secondary objective are the three main division of injury healing. the different divisiones occur, Interactions of cellular and extracellular components are identical,. A fourth division is the healing that nominate with wounds that are only fractional skin thickness.<sup>[6]</sup>

There are a numeral of hormones concerned with energy production, anabolism or proteinformation, and catabolism or protein breakdown. The balance of anabolic and catabolic hormones affects injury healingjointlyindirectly by the situation of overall net protein formation and directly by improving the injury healing process, for example the Human Growth Hormone HGH has a numeral of metabolicinfluences. The most notable is it`s anabolic effect. HGH increases the flowing of amino acids in the cell and decreases the efflux. Cell proliferation is feature as is overall protein formation and new tissue growth.<sup>[7]</sup>

The function of prostaglandins in Starting human disease has been vastly studied predominately in inflammatory disorders, After initial vasoconstriction, the vintage signs of inflammation manifest from increased vascular permeability. This response is followed by vasodilatation, intermediateby prostacyclin (PGI<sub>2</sub>), prostaglandin A (PGA), prostaglandin D (PGD), and prostaglandin E (PGE).

These changes are potentiated by PGE<sub>2</sub> & prostaglandin F<sub>2α</sub> (PGF<sub>2α</sub>) and cells inflammatory into the region of injury.<sup>[8]</sup>

GH has a numeral of metabolicinfluences, but the most notable is permit the ingress of its anabolic effect. Cell proliferation is feature as is overall protein formation and new tissue growth. GH also induceIGF-1 production by the liver and some of anabolism seen with HGH is that produced by IGF-1, another anabolic representative.

Also its direct injury healing influences, skin is target tissue for HGH, jointly directly out of

HGH receptors on the epidermal cells surface and indirectly out of the action of IGF - 1.30,34. Exogenously managed in normal humans HGH has been shown to increase skin thickness.

Other influences on the injury include increased rate of re-epithelialization of skin graft granter sites in adults and children with acute burns or trauma. Also HGH has been increased injury collagen content, granulation tissue and injury tensile strength, the native product of IGF-1 by fibroblasts.<sup>[9]</sup>

Laser beam was first applied in medicine when a major laser beam instrument was built by T. Maiman in 1960. The first low-level laser beam for tissue bio stimulation was applied by E. Mester in 1969. Despite first doubts concerning its capacity, low level laser beam therapy (L.L.L.T.) has been applied for thirty years, and it has occupied an notable place in medicine. The domain of L.L.L.T.'s medical applications in tissue prompting continues to rise, as new instruments are formed.

Continued research into tissue bio stimulation has showed that L.L.L.T. Has a useful living organisms.<sup>[10]</sup> effect on Surgical wounds maybe perfunctory or profound on skin or mucous membranes due to a surgical intervention using a scalpel to cutout of skin or mucosa and the implied tissue. Low Level Laser beam Therapy L.L.L.T. has been applied for treating the injury for over two decades in many medical making easy of the world. It proved to be useful and efficient in order that the initial healing was induce. The process comes to an end in The tenth postoperative day.<sup>[11]</sup>

### **Classification and kinds of wounds**

There are many several pathways in which injury can be classified. In many cases injury may contain, a integration of various kinds.<sup>[12]</sup>

5- Based on the Nature and Depth, Injuries Can be Categorized as<sup>[13]</sup>

<b>1. Injury thickness</b>	
<b>Superficial</b>	Include only the epidermis and the upper dermis.
<b>Partial thickness</b>	include skin absence up to the lower dermis.
<b>Full thickness</b>	include skin & sub cutaneous tissues.
<b>Deep and complicated</b>	include penetration into natural cavities, tissue or an organ
<b>2. Injury complexity</b>	
<b>Simple</b>	Affecting only one tissue or organ.
<b>Combined</b>	Affecting multiple organs and/or tissue.
<b>3. Injury age</b>	
<b>Fresh</b>	high to 8 hours from the time of injury.
<b>Old</b>	After 8 hours from the time of injury.
<b>4. Injury origin</b>	
<b>Superficial</b>	Breaking the surface of skin of scratching, rubbing, picking, or a graze from falling.
<b>Incised</b>	as outcome of surgical intervention.
<b>Crush</b>	Made with a powerful hit of a cutting device, e.g. hatchet, sword
<b>Lacerated</b>	Segments of tissue rupture away with a sharp-edged object.
<b>Stab</b>	Made with a pointed device, or weapon.
<b>Cont applied</b>	Injury to tissue under the skin's surface, most combined injury kind seen in traffic accidents.
<b>Secondary</b>	injuries originating from initial diseases, e.g. diabetic ulcers, pressure ulcers, venous ulcers
<b>Other</b>	shot injury, bite injury, poisoned injury

❖ **Open wounds**

Open wounds are those injuries in which the wounded region is entirely uncovered to exterior environment and highly susceptible to infection.<sup>[14]</sup>

Open wounds are categorized based on the object that applied the wound. Kinds of open wounds are:<sup>[13]</sup>

- **Incisions or incised wounds**, any acute cut in which the tissues are not severed; a clean cut applied by a keen cutting device – the injury perhaps aseptic or septic, depending on the cases of affairs,<sup>[15]</sup>
- **Lacerations**, a laceration is a injury that is make by the rupture of soft body tissue. This kind of injury is often thumping and jagged. A laceration injury often polluted with bacteria and wreckage from whatever object applied the cut.<sup>[16]</sup>
- **Abrasions**, cursory wounds in which the upper layer of the epidermis is scrape. Abrasions are often applied by a sliding fall onto a jagged surface., also called scrapes,

which happen when the skin is scrub away by friction against another jagged surface.<sup>[14]</sup>

- A **puncture**, puncture injury is generally, applied by acute pointy object like a nail, teeth of animal, or a tack. The kind of injury always does not bleed over much and can show to close up.<sup>[15]</sup>



**Fig. (1): Kinds of Open Wounds; R, Lacerated, L, Puncture Wound.**

- **Penetration wounds**, in which the skin is cracked and there preventative causing the injury enters subcutaneous tissue or a deep lying structure or cavity (there preventative might be a nail, splinter or spike).<sup>[14]</sup>
- **Gunshot wounds**, caapplied by a shot or like projectile driving to orout ofthe body. There perhaps two injuries, one at the site of entrance and one at site of emergence, such is generally known as a through-and-through.

#### ❖ Closed wounds

Closed wounds are those in which the injury occurs below the skin due to impose blunt or trauma resulting in the harm of tissue and blood vessels. these wounds are also formed by mostamount of impose applied over a long period of time,<sup>[13]</sup>

Closed wounds have fewer division, but are just as seriousas open wounds. Thekindsof closed wounds are:

- Contusions,
- Hematomas,
- Crush injury,

#### Laser beam

The word laser beam is acronym for the words; Light Amplification by Stimulated Emission

of Radiation, it's one of the outstanding discoveries of the second half of the last century which has become a valuable tool in a diversity of fields starting with medicine to telecommunication. It is a light source but it's very highly different from many conventional light sources.

We can't use the beam of laser for lightening objective as other light sources in order that it produces a highly directional and high strength radiation with a tight frequency domain than that available from the combined kind of light sources.

So laser beams are more vastly applied as a high power electromagnetic radiation rather than the light radiation. The radiation of laser beam is applied as a special kind of pursuit bit to pursue holes in arduous materials, as a sawing to cut durable metal sheets, as a phonograph needle for compact discs, as a knife during surgical operations, as a target designator for military weapons and so on. Thus, it's a high technology device affecting our lives in many pathways.<sup>[17]</sup>

Low Level Laser beam Therapy is also known as Low strength Light Therapy (L.I.L.T.), cold laser beam, phototherapy, light therapy, low-energy laser beam therapy, photo biomodulation among other L.L.L.T.

Typically, laser beams applied for therapeutic purposes fall in the red and near-infrared domains of electro magnetic radiation and thus in the non-ionizing domain. The wavelength domain for red light is 630 - 700 nm & the domain for near-infrared radiation is 700 nm to 1 mm. Therapeutic laser beams use these wavelengths in order that other wavelengths are absorbed by melanin pigment in skin, hemoglobin in blood or water in the tissues and thus do not go up to the mitochondria of the target tissues. In addition, studies have shown that wavelengths in the red out of near-infrared spectrum (630-900 nm) are better absorbed by the iron or copper atoms correlating with the cytochrome system in mitochondria for ATP product.<sup>[18]</sup>

### **Laser beam Tissue Interaction**

Different species of laser beams react variously with tissue. The wavelength of the laser beam is of initial significance. However the power density and exposure period also play a critical function in determining tissue interaction. When a radiation of laser beam light strikes the surface of living tissue, one of the four basic physical events may take place.

**Reflection:** The redirection of a ray of light from its effect point on the limits surface between diverse media back to the hemisphere of space, centered at the effect point, from which that ray found, in such a way that the angle of descent is equal to the angle of reflection (both measured from the columnar to the reflecting surface in the plane defined by the happening and reflected rays).

**Transmission:** inside, or through, the tissue. expansion, can be defined as a variation in direction of a light ray without a variation in wavelength.

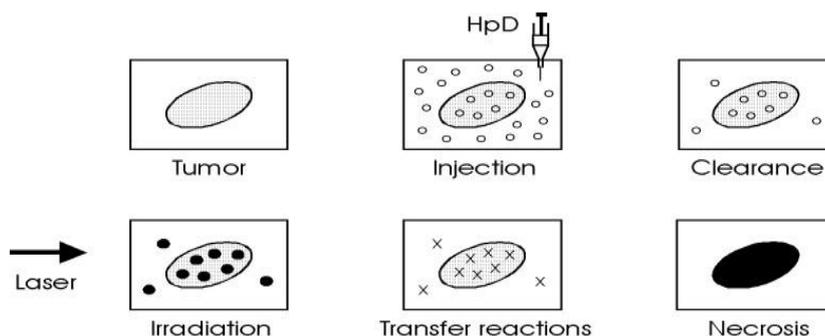
**Absorption:** of radiating energy happen at the level of atoms, ions, molecules, and radicals (collections of atoms that pass unchanged out of chemical reactions, but perhaps incapable of present alone). It is a process of conversion of the radiating energy into other forms of energy.<sup>[19]</sup>

A diversity of interaction mechanisms may happen when stratify laser beam light to biological tissue. Specific tissue features as well as laser beam parameters share in to this diversity. Most significant among optical tissue characteristics are the coefficients of reflection, absorption, and scattering which, jointly, determine the total transition of the tissue at specific wavelength.

Although the numeral of possible collections for experimental parameters is un limited, fundamentally five division of interaction kinds are categorized today. These are photo chemical interactions, thermal interactions, photo ablation, plasma-induced ablation, and photo disruption.

**1- Photo chemical Interaction:** A group of photo chemical interactions stems from experimental notices that light can stimulate chemical influences and reactions in macro molecules or tissues. One of the most common examples is the photosynthesis. In the field of medical laser beam physics, photochemical interaction mechanisms play important job through photo dynamic therapy (PDT). Considerably, biostimulation is also referred to photo chemical interactions.

**a- Photo dynamic Therapy (PDT):** Photo dynamic therapy is performed as: first, a photo sensitizer, e.g. hemato porphyrin derivative (HpD), is injected to a vein of the patient.



**Fig. (12): Scheme of photo dynamic therapy.**

Within the next few hours, HpD is expanded among all soft tissues except the brain. The basic feature of a photo sensitizer is that it remains in active until irradiated. After 48–72 hours, most of it is evident from healthy tissue, its focus in tumor cells has not reduce much even after time of 7–10 days.

Thus, HpD does not collect in tumor cells directly after injection, but these cells show a longer storage ability (affinity) for HpD. The initial focus is the same in healthy cells, but the riddance is rapid in the latter cells.

After three days, the HpD focus in tumor cells is about thirty times more than in well cells. Laser beam usually happen after the third day and upward. If some treatments are needed on the seventh day after injection. In this time, tumor cells as yet susceptible and eclectic necrosis of tumor cells is become strong. However, plentiful well tissues may keep certain ingredient of HpD, so thus are photo sensitized.

b- Bio – stimulation happen at quite low beams and belong to the set from photo chemical actions. Injury healing and anti-inflammatory characteristics by red or near infrared light sources like helium– neon laser beams or diode laser beams were communicate. Native injury healing influences for helium – neon He – Ne or diode laser beams perhaps explained by the action of low-intensity light on cell proliferation. In the region of such injuries, conditions are commonly created preventing proliferation like low oxygen focus or pH. The insinuation to red or near infrared light may Thus serving as an incentive to raise cell proliferation.

**2- Thermal Interaction:** the expression thermal interaction stands for a large set of interaction kinds, where the excess in native temperature is significant parameter variation. The influences of Thermal can be encouraged by either CW or pulsed laser beam. count on the while and top amount of the tissue temperature carried out, several influences like

coagulation, volatility, carbonization, and fusion perhaps prominent.

- a- Coagulation:** through the procedure of coagulation, temperatures amount to fully 60°C, and coagulated tissue be necrotic.
- b- Vaporization:** vaporization is indicate to sometimes as a thermo mechanical effect due to the pressure build-up implicated. The result of ablation is Named thermal decomposition, when a laser beam beating a tissue. Water strongly absorbs its wavelength leading to vaporization within these layers.
- c- Carbonization:** In this situation, excessive energy was utilized and carbonization take place. Thus, the native temperature of the bared tissue had been increased. At temperatures over approximately 100°C, the tissue beginning to carbonize, carbon is freed, directing to a blackening in color.
- d- Melting:** Temperature have to reach a little hundred degrees to meltdown for ex. the tooth material which principally consists of hydroxyapatite, a chemical complex of calcium and phosphate, the pulse period of a little microseconds is yet long suitable to enable a enough increase in temperature, since the average of applied repetition of 1 Hz is very low.

**Table (2): Thermalinfluences of Laser Beam.**

Temperature	The biologicalinfluences
37°C	ordinary
45°C	Hyper thermia
50°C	decrease the enzyme activity, cell stagnancy
60°C	proteins and collagen, coagulation Denaturation
80°C	The membranes Permeabilization
100°C	Vaporization, thermal dismantling (eradication)
> 100°C	Carbonization
> 300°C	fusion

- 3- Photo Ablation:** Photo ablation was first find out by Srinivasan and Mayne - Banton (1982). They specific it as ablative photo decomposition, meaning that substance is break down when exposition to high dense laser beam. model threshold rate of this kind of interaction are 107–108 W/cm<sup>2</sup> at laser beam pulse periodes in the nanosecond domain.

The Penetration depth, i.e. the profundity of tissue removal per pulse, is limited by the pulse energy up to a confirmed saturation frontier. The geometry of the ablation style itself is know by the specific quantification of the laser beam. The fundamental features of this ablation technique place in the precision of the etching procedure, its stellar predictability, and the

deficiency of thermal harm to an neighboring tissue.

- 4 Plasma- Caused by Ablation: when obtaining force intensity, exceeding  $10^{11}$  W/cm<sup>2</sup> in solids and fluids – or  $10^{13}$  W/cm<sup>2</sup> in air – a phenomenon known as optical breakdown happen. If some laser beam pulses are utilized, a exemplary sparking fuss at recurrence average of the pulses is audible. By means of plasma-induced ablation, so clean and well-know abstraction of tissue without proof of thermal or mechanical harm can be completed when selecting suitable laser beam parameters. Sometimes, plasma-induced ablation also indicate to as plasma-mediated ablation.
- 5 Photodisruption: The physicalinfluences correlating with optical collapse are plasma forming, and shock waveformation. If breakdown happen inside soft tissues or fluids, cavitations and jet composition may additionally happen. Within higher pulse energies – and thus higher plasma energies – shock waves and other mechanical sideinfluences be more important and might even limited the global effect upon the tissue. Primarily, this is due to the fact that mechanicalinfluences scale linearly with the absorbed energy. Then, in order that of the mechanical impact, the term disruption (from Latin: ruptus = ruptured) is more appropriate.<sup>[20]</sup>

## REFERENCES

1. Nayeem, N. & Karvekar Injury Healing International Journal of Applied Biology and Pharmaceutical Technology, 2010; 1369: 1-3.
2. Dunnia A. Barakat, Ihsan, F. Rostum & Sattar H. Ali. Accelerating Injury Healing and Skin Loss Sealing Using Low Level Laser beam Therapy. Iraqi Laser beam Scientists Journal, 2017; 1(1): 1-10.
3. Robles, T. D. and Berg, D. Abnormal injuryhealing: keloids, Clinics in Dermatology, 2007; 25: 26–32.
4. Mercandetti, M. & Cohen, A.J. Injury Healing, Healing and Repair, *Medscape*, Mar 27, 2008; 38(3): 211-15.
5. Koh-Knox, C. P. and Sussman, G. InjuryCare in an Aging Population: Special Considerations, ACPE Program I.D. Number: 0105-999-04-902-H01 *Pharmacy Times/Ascend Media Office of Continuing Professional Education accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education*, 2007.
6. Mercandetti, M. & Adam, J. Cohen, Injury Healing, Healing andfixture Department of

- Surgery, Doctors Hospital of Sarasota & Eyelid and Facial Aesthetic and Reconstructive Surgery, Diseases and Surgery of the Orbit and Lacrimal System, Cosmetic Laser beam Surgery. Medscape, <http://www.medscape.com/public/help> , Mar 27, 2008.
7. Deodhar AK, Rana RE.: Surgical physiology of injuryhealing: a review. J Postgrad. Med., cited, Nov 26, 2010; 43: 52. Available in: <http://www.jpgmonline.com/text.asp?1997/43/2/52/406>.
  8. Torre, J. I. & Chambers, J.A. Injury Healing, Chronic Wounds, *Medscape*, Oct 9, 2008; 56(4): 409-15.
  9. Robert H. Demling; The Functionof Anabolic Hormones for Injury Healing in Catabolic States, Journal Of Burns And Wounds, 2005; 4: 46-62. www, Journal Of Burns And Wounds.com, rhdemling@partners.org
  10. Chyczeweski, M.; Rozica, A.; Micolaczyk, A.; Rotkiewicz, T.; Holak, P.; Jaylinski, M.; & Rotkiiewicz, Z. Effect of laser beam biostimulation on cell proliferation in the healing of cutaneous surgical wounds in pigs. *Bull Vet Inst Pulawy*, 2010; 54: 217-221.
  11. Calin, M. A.; Coman, T. and Calin, M. R. The effect of Low level laser beam therapy on injuryhealing, Romanian Reports in Physics, 2010; 62(3): 617–627.
  12. Ngan, V. Wounds. Derm Net NZ, 2010. <http://www.dermnet.org.nz/nzds.htm/>.
  13. Nayeem, N. and Karvekar. INJURYHEALING: A REVIEW. Department of pharmaceutical chemistry, Krupanidhi College of Pharmacy, chickabellandur, varthur hobli, Bangalore-35, INDIA, IJABPT. ISSN 0976-4550. International Journal of Applied Biology and Pharmaceutical Technology, Nov-Dec 2010; I(3): 1369-1377. Available online at [www.ijabpt.com](http://www.ijabpt.com).
  14. Honnesh, N.H, Preparation of exterior herbal formulation for injuryhealing activity. ©Rajive Gandhi University of Health Science, Karnataka, 2010.
  15. Mallefet, P. and Anthony, C. Dweck. Mechanisms concerned in injuryhealing. THE BIOMEDICAL SCIENTIST. the IBMS, 2008; 609-615. [www.ibms.org](http://www.ibms.org).
  16. John, E. Duldner and Zieve, D. (2008). Laceration versus puncture wound. A.D.A.M., American Accreditation Health Care Commission ([www.urac.org](http://www.urac.org)).
  17. Avadhanulu, M.N. (2009) An Introduction to laser beams Theory and Applications. Published by S.Chand & Company Ltd, 7361, Ram Nagar, New Delhi-110055.ISBN:81-219-2071-X, An ISO 9001: Company), 2000; 166.
  18. Dais, J. (2009). Low Level Laser beam Therapy Position Paper for the CMTBC: An Examination of the Safety, Effectiveness and Usage of Low Level Laser beam Therapy for the Treating the Musculoskeletal Conditions.

19. John C. Fisher: Qualitative and Quantitative Tissularinfluences of Light fromsignificant Surgical Laser beams: Optimal Surgical Principles , Interaction of Laser beam Light with Living Tissue, 2007; 4: 58-81, The American Board of Laser beam Surgery Inc., 2007.
20. Markolf, H. Neimz; Laser beam Tissue Interaction, Fundamentals and Applications, Interaction Mechanisms, 3: 45-149. 3<sup>rd</sup>. Enlarged Ed. ISBN 978-3-540-72191-8 3rd Edition Springer Berlin Heidelberg New York, Springer-Verlag Berlin Heidelberg, 2004, 2007; 3: 45-149.