



# Low Level Laser Therapy on Treating Hair Loss

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*Abstract: male pattern hair loss (MPHL) and female pattern hair loss (FPHL) is one of the most important modern problems. Low-level laser shows its ability for hair regrowth. In this article, we will talk about the laser light such as its types and its effects on tissues and present some randomized experiments that were performed on animals and others on humans of both sexes to determine their response to the treatment through the evidence-based medicine, We also present the latest discoveries such as the use of laser in the house, which is currently attached to the laser hat and we presented one of the experiments that were carried out using this device on groups of men and women.*

*Keywords: Evidence-based medicine, female pattern hair loss (FPHL), Hair regrowth, male pattern hair loss (MPHL), low level laser therapy (LLLT).*

## 1. INTRODUCTION

The laser is electromagnetic radiation with identical wavelengths and frequencies in the waveform, transforms into a high-energy, highly coherent photonic pulse with very small diffraction angles [1]. In 1917s Einstein was the first to establish the theoretical foundations of laser light. In 1960, the first laser beam device was manufactured [2].

There are many types of lasers, depending on the wavelength, the technique followed, the type of material and the color, the laser emitted by different gases, and it is called the gas laser [3]. There are chemical lasers produced by various chemical reactions, as well as solids, semiconductor lasers, and infrared lasers [4].

The laser is considered one of the safest and most reliable methods [5]. We will focus here on the use of low-level laser specifically in the treatment of hair loss. In 2002s [6] the ability of the laser to stimulate hair growth was observed by chance when they tested if the laser light causing cancer in rats with their hair shaved they noticed that the hair growth rate in the group exposed to laser light was faster than the other one. [7], [8] Low-level laser therapy devices have been developed for home use that emits low-energy monochrome light rays for various diseases, including hair growth [9].

## 2. STUDY OF THE THEORETICAL FRAMEWORK OF LOW LEVEL LASER THERAPY (LLLT)

### 2.1 Origin And Concept of Laser Light

LASER is the first letter of the idea of laser work, which is represented in the following sentence: Light Amplification by Stimulated Emission of Radiation, in 1916 Albert Einstein suggested that the atoms could release energy either spontaneously or when stimulated by light. German physicist Rudolf Walther Ladenburg first observed stimulated emission in 1928s. [10]

In 1951s Charles H. Townes found a way to generate stimulated emission at microwave frequencies. In the late of 1953s, [11] he demonstrated a working device that focused excited ammonia molecules in a resonant (microwave cavity), where they emitted a pure microwave frequency it's named (maser) from the first words of this operation (microwave amplification by the stimulated emission of radiation) [12]. Aleksandr Mikhailovich Prokhorov and Nikolay Gennadiyevich Basov of the P.N. Lebedev Physical Institute in Moscow independently described the theory of (maser) operation, those three researchers got the 1964 Nobel Prize for Physics.

in the mid of 1950s, the researchers continue working on the (maser) but they found only a few ranges of applications as low-noise microwave amplifiers and atomic clocks. The scientist Townes in 1957s proposed to his brother and a former postdoctoral student at Columbia University, Arthur L. Schawlow, that they try to extend maser action to the much shorter wavelengths of infrared or visible light. Those three scientists published their ideas on seminal paper about the (optical maser) in late of 1958. but the scientist Gould was faster than them and suddenly coined the word laser and wrote a patent application. Gould received four patent starting from 1977s.

The scientist Theodore H. Maimane fired bright pulses from a photographer's flash lamp to excite chromium atoms in a crystal of synthetic ruby, on 1960s he produced red pulses from a ruby rod about the size of a fingertip. Ali Javen, William Bennett, Jr., and Donald Herriot in 1960s made the first gas laser, it was a mixture of helium and neon which generated a continuous infrared beam. In 1962 Robert N. Hall at the General Electric Research Center In New York, made the first semiconductor laser. [13]

**Table1:** Show the development of laser sources and the first studies.

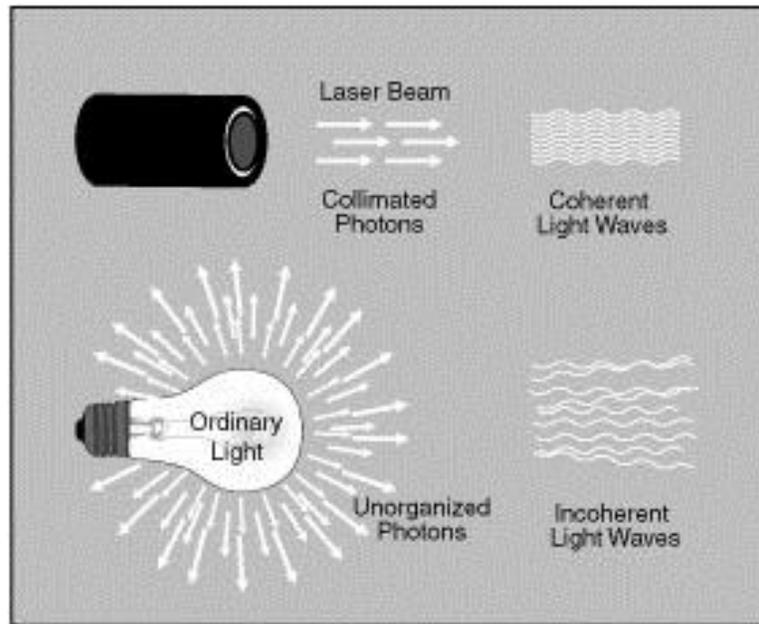
Laser Type	Wavelength, nm	Year [Reference]	Reference
Ruby	694	1960 [26]	[14],[15],[16],[17]
Nd:YAG	1064	1964 [27]	[18],[19]
Nd:YAG (KTP)	532	1963 [28]	[20]
CO <sub>2</sub>	10600	1964 [29]	[21],[22]
Helium-Neon (He-Ne)	633 (basic), 544; 594; 612; 1152; 1520;	1960 [30]	[23],[24]
Helium-cadmium (He-Cd)	3391 (rarely used)	1968 [31]	[25]
Semiconductor (diode)	442	1962 [32]	LILI wavelength 405, 445, 525, 635, 785, 808, 830, 904 and 1300 nm

### 2.2 Laser Types

1. Gas Laser (CO<sub>2</sub> laser, Excimer LASER)
2. Dye Laser
3. Semiconductor Laser (Semiconductor LASER)
4. Solid State Laser (Neodymium-YAG LASER)

### 2.3 Laser Properties

- 1) Single wavelength (monochromatic):
- 2) Parallel beams(Collimation):
- 3) Cohesion
- 4) High Intensity

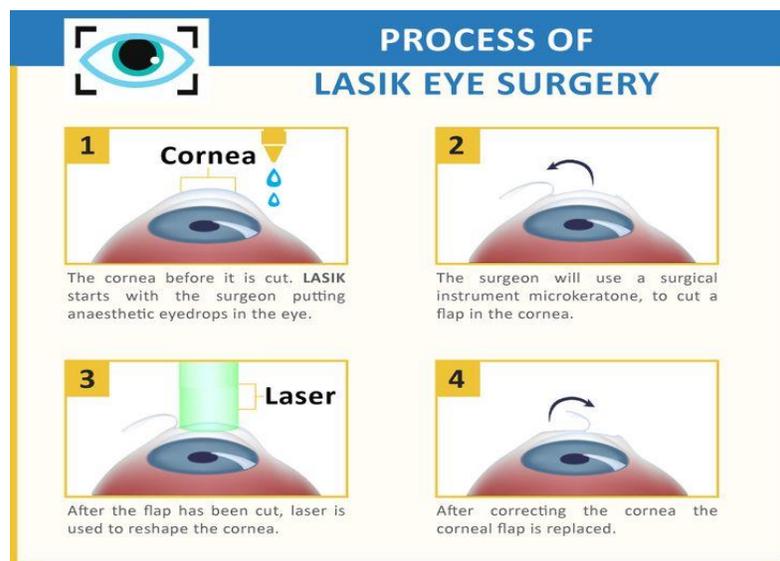


**Figure1:** Shows the laser beam properties. [33]

### 2.4 Laser Medical Applications

Here are some brief points for using laser in medicine:

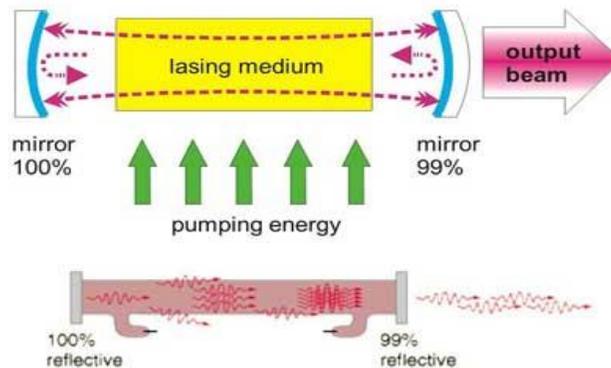
1. In peripheral neurosurgery and after surgery
- 2 - healing the wounds
- 3 - tendon inflammation
4. As an alternative to laparoscopic surgery.
- 5 - as an alternative to lower back surgery
6. The laser treats Bell's paralysis with 100% cure.
7. eye treatment



**Figure2:** Shows using the laser beam for eye treatment. [34]

### 3. HOW THE LASER BEAM IS GENERATED

The laser device is composed of several parts, namely the center or crystal for the production of laser light and electric energy to stimulate the center to be able to send light waves, and reflector in addition to the lens exit beam, and may be either level or concave and laser output, and begins the work of this device by reversing atoms of light Color or wavelength between the mirror and the lens where excited atoms emit electromagnetic waves due to the descent of electrons from high-energy orbits to low-energy orbits, but not automatically and randomly, but as a result of Ray has a specific frequency. The induced radiation of the excited material is called coherent, because the electromagnetic waves caused by the electron's descent have a frequency and a phase that is exactly equal to the frequency and development of the waves that the electrons searched for radiation. Therefore, this radiation has one frequency Theory. The radiation frequency emitted from the material can be calculated by dividing the energy difference between the two orbits between the electrons and the Planck constant. The process of stimulation and activation of the center, this process is one of the characteristics of crystallization, and the light waves to a state of equilibrium after the occurrence of successive reflections within the center, and graduated from the center in the form of a laser beam of high energy.



**Figure 4:** shows the cavity of the laser beam. [33]

### 4. HAIR LOSS TREATMENT BY LOW LEVEL LASER THERAPY

Laser hair loss treatment is based on the use of low-light laser Lasers. Such cold radiation was invented in Europe for use in wound healing, but later developed and proved effective in treating hair loss and some skin diseases that are commonly suffered by the scalp.

When the patient undergoes laser treatment, the doctor uses several laser devices, all connected to a rotating head with a cap head attached to the highest areas of hair loss. During the treatment, the cap is lowered towards the head so that the laser beam can move directly towards the scalp.

Experts have confirmed that treatment of laser hair loss usually comes to fruition with cases of hair loss genetic or progressive caused by stress.

Eighty percent of patients with hereditary hair loss had increased their intensity after a few months of laser therapy. Those who complained of progressive hair loss had a significant reduction in the rate of hair loss during a short period of time with low level laser therapy (LLLT).

### 5. LLLT FOR HAIR GROWTH IN CLINICAL TRIALS

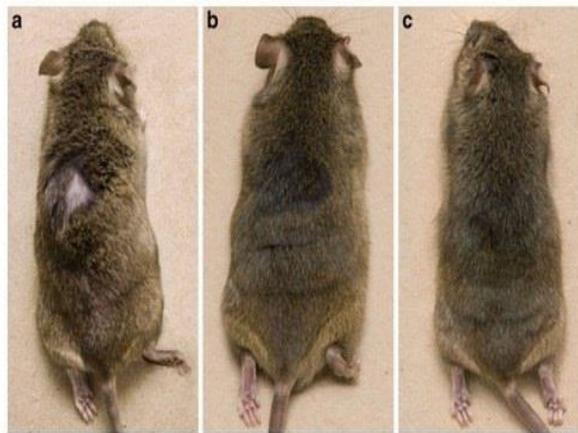
There is a series of studies on low-level laser hair loss treatment here we will present some of them:

#### 5.1 Study of 2012

This study was on tow groub of mice groups .

The first group was exposed to the low-level laser package for three seconds each week and the experiment lasted for six weeks.

The second group was treated with drugs and antibiotics. The group treated with laser hair growth has faster than the second group and increased its density as well.



**Figure 5:** The majority of hair follicles in mice from the 6-week laser therapy group were in rapid growth.[35]

### 5.2 Study of 2014

An experiment was conducted on 269 people (128 males and 141 females). All of them suffer from hair loss.

They were divided into four groups

The first group was on 78 females where they were exposed to a 9-beam laser beam.

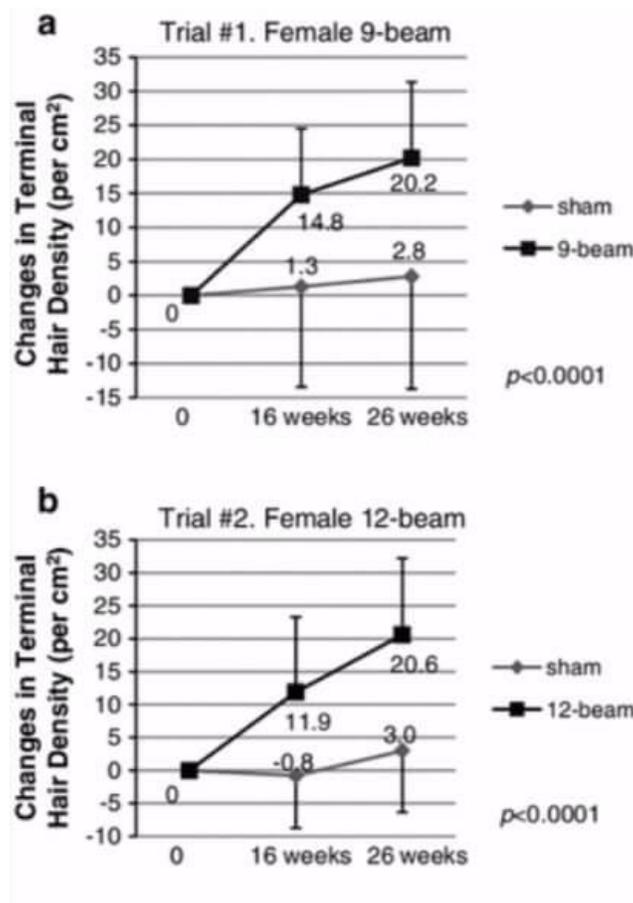
The second group consisted of 63 females using a 12-beam laser.

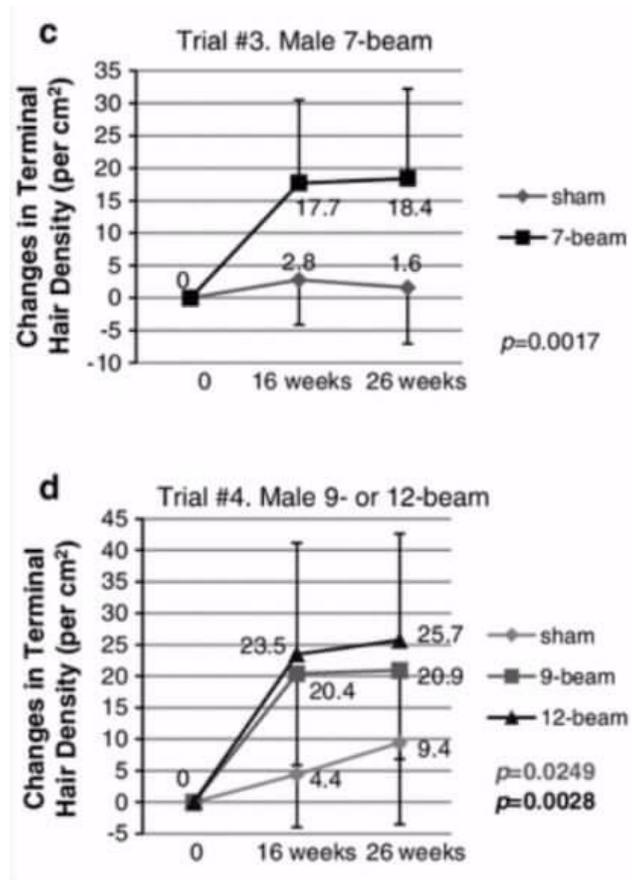
The third group was infected with 49 male patients who received treatment using a 7-pack laser.

The fourth group was infected with 79 male patients who received treatment using a laser with 9 and 12 beams.

Hair density has been increased within 26 weeks of starting treatment.[35]

The results was as follows:





## 6. CONCLUSION

Laser light is the future in various fields of medical and surgical applications and the new researches discovered the ability of low-level laser therapy or the red light laser to stimulate the growth of hair and through the presentation of several laboratory experiments, some of them were on animals and the other part on the human proved it is very useful and safe in terms of stimulating hair regrowth and increase its density so there is a need for further experiments and research on laser applications, especially in the area of stimulating hair growth.

## REFERENCES

- [1]. Schindl A, Schindl M, Pernerstorfer-Schon H, Schindl L. Low-intensity laser therapy: A review. *J Investig Med*. 2000;48(5):312–326.
- [2]. Bjordal JM, Couppe C, Chow RT, Tuner J, Ljunggren EA. A systematic review of low level laser therapy with location-specific doses for pain from chronic joint disorders. *Aust J Physiother*. 2003;49(2):107–116.
- [3]. Silva GB, Mendonca EF, Bariani C, Antunes HS, Silva MA. The prevention of induced oral mucositis with low-level laser therapy in bone marrow transplantation patients: A randomized clinical trial. *Photomed Laser Surg*. 2011;29(1):27–31.
- [4]. Metelitsa AI, Green JB. Home-use laser and light devices for the skin: An update. *Semin Cutan Med Surg*. 2011;30(3):144–147.
- [5]. Mester E, Szende B, Gärtner P. The effect of laser beams on the growth of hair in mice. *Radiobiol Radiother (Berl)* 1968;9:621-6.
- [6]. Moreno-Arias G, Castelo-Branco C, Ferrando J. Paradoxical effect after IPL photoepilation. *Dermatol Surg* 2002;28:1013-6.
- [7]. Olsen EA, Messenger AG, Shapiro J, Bergfeld WF, Hordinsky MK, Roberts JL, et al. Evaluation and treatment of male and female pattern hair loss. *J Am Acad Dermatol*. 2005;52(2):301–11.
- [8]. Hoffmann R, Happle R. Current understanding of androgenetic alopecia: Part I. Etiopathogenesis. *Eur J Dermatol*. 2000;10(4): 319–27.

- [9]. Gan DC, Sinclair RD. Prevalence of male and female pattern hair loss in Maryborough. *J Investig Dermatol Symp Proc.* 2005;10(3):184–9.
- [10]. R. Roelandts, The history of phototherapy: something new under the sun?, *J Am Acad Dermatol* 46 (2002) 926-30.
- [11]. A.N. Pereira, P. Eduardo Cde, E. Matson and M.M. Marques, Effect of low-power laser irradiation on cell growth and procollagen synthesis of cultured fibroblasts, *Lasers Surg Med* 31 (2002) 263-7.
- [12]. J.S. Kana, G. Hutschenreiter, D. Haina and W. Waidelich, Effect of low-power density laser radiation on healing of open skin wounds in rats, *Arch Surg* 116 (1981) 293-6.
- [13]. A.P. Sommer, A.L. Pinheiro, A.R. Mester, R.P. Franke and H.T. Whelan, Biostimulatory windows in low-intensity laser activation: lasers, scanners, and NASA's light-emitting diode array system, *J Clin Laser Med Surg* 19 (2001) 29-33.
- [14]. Mester E, Ludani G, Selyei M, Szende B, Total GJ. The stimulating effect of low power laser rays on biological systems. *Laser Rev.* 1968;1:3–8.
- [15]. Mester E, Ludany G, Sellyei M, Szende B, Gyenes G, Total GJ. Studies on the inhibiting and activating effects of laser beams [German] *Langenbecks Archiv fur Chirurgie.* 1968;322:1022–7.
- [16]. Mester E, Ludany G, Sellyei M, Szende B. On the biologic effect of laser rays [German] *Bull Soc Int Chir.* 1968;27(1):68–73.
- [17]. Rounds DE, Chamberlain EC, Okigaki I. Laser radiation of tissue cultures. *Ann N Y Acad Sci.* 1965;28(122):713–27.
- [18]. Abergel RP, Meeker CA, Dwyer RM, Lesavoy MA, Uitto J. Nonthermal effects of Nd:YAG laser on biological functions of human skin fibroblasts in culture. *Lasers Surg Med.* 1984;3(4):279–84.
- [19]. Castro DJ, Abergel RP, Meeker CA, Dwyer RM, Lesavoy MA, Uitto J. Effect of the Nd:YAG laser on DNA synthesis and collagen production in human skin fibroblast cultures. *Ann Plastic Surg.* 1983;11(3):214–22.
- [20]. Rounds DE, Olson RS, Johnson FM. The laser as a potential tool for cell research. *J Cell Biol.* 1965;27(1):191–197.
- [21]. Astafieva OG, Panchenkova GF, Gorbatenko EA. General interaction of laser irradiation with organs and tissues [Russian] *Saratov: Saratov University press; 1980.* 38-51.
- [22]. Koshelev VN, Tarkhov GN, Astafieva OG, et al. Some problems of wound healing stimulation [Russian]. *Materials of all-Union. conf. "The use of methods and means of laser technology in biology and medicine". Kiev: Naukova dumka; 1981:37-40.*
- [23]. Inyushin VM. On the question of biological activity of red radiation [Russian]. *Alma Ata; 1965:22*
- [24]. Inyushina TF, Inyushin VM. About the action of laser light on erythropoiesis [Russian]. *Nekotoryye voprosy teoreticheskoy i prikladnoy biologii. Alma-Ata; 1967:113-5*
- [25]. Shchur VV, Morozova VA, Shapiro AM, et al. Mathematical analysis of biological effect of helium-cadmium optical quantum generator in experiment on animals [Russian]. *Gigiyenicheskiye aspekty ispol'zovaniya lazernogo izlucheniya v narodnom khozyaystve. Moscow; 1982:120-122.*
- [26]. Maiman TH. Stimulated optical radiation in ruby. *Nature.* 1960;187:493.
- [27]. Geusic JE, Marcos HM, Van Uitert LG. Laser oscillations in ND-doped yttrium aluminum, yttrium gallium and gadolinium garnets. *Appl Phys Letters.* 1964;4(10):182.
- [28]. Franken PA, Ward JF. Optical harmonics and nonlinear phenomena. *Rev Mod Phys.* 1963;35(1):23–39.[Google Scholar]
- [29]. Patel CKN. Continuous-wave laser action on vibrational-rotational transitions of CO<sub>2</sub>. *Phys Rev.* 1964;136(5A):A1187–A1193.
- [30]. Javan A, Bennett WR Jr, Herriott DR. Population inversion and continuous optical maser oscillation in a gas discharge containing a He-Ne mixture. *Phys Rev Letters.* 1961;6(3):106–113.
- [31]. Silfvast WT. Efficient CW laser oscillation at 4416°A in Cd (II) *Appl Phys Letters.* 1968;13(5):169–71.
- [32]. Hall RN, Fenner GE, Kingsley JD, Soltys TJ, Carlson RO. Coherent light emission from GaAs junctions. *Phys Rev Letters.* 1962;9(9):366–8.
- [33]. Properties Of A Laser Beam May 27, 2018 - Arfan <http://www.fotoimage.org/properties-of-a-laser-beam/>
- [34]. Laser Eye Surgery- Physics/Optics STSE Monday, 16 January 2017 <http://snc2dalbrecht.blogspot.com/2017/01/laser-eye-surgery-physicsoptics-stse.html>
- [35]. Leavitt M, Charles G, Heyman E, Michaels D. HairMax Laser Comb laser phototherapy device in the treatment of male androgenetic alopecia: a randomized, double-blind, sham device-controlled, multicenter trial. *Clin Drug Invest.* 2009; 29:283–292.