

Laser in medical application

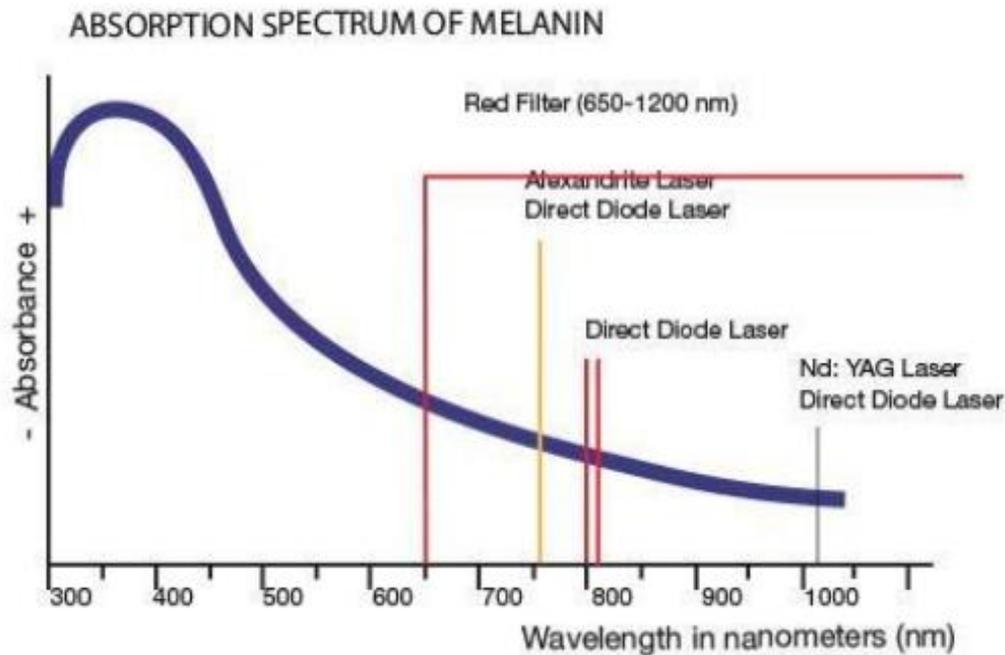
Laser Effects on The Skin and Dermatology

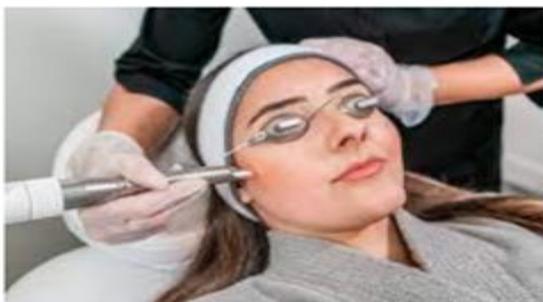
Lasers in Dermatology

The first lasers used to treat skin conditions occurred over 40 years ago. Argon and carbon dioxide (CO₂) lasers were commonly used to treat benign vascular birthmarks such as port-wine stains and hemangiomas.

Although these birthmarks could be effectively lightened, a side effect was the unacceptably high rate of scar formation. In the last 20 years, advances in laser technology have revolutionised their use in the treatment of many skin conditions and congenital defects, including vascular and pigmented lesions, and the removal of tattoos, scars and wrinkles.

There is a spectrum of laser and light technologies available for skin resurfacing and rejuvenation.

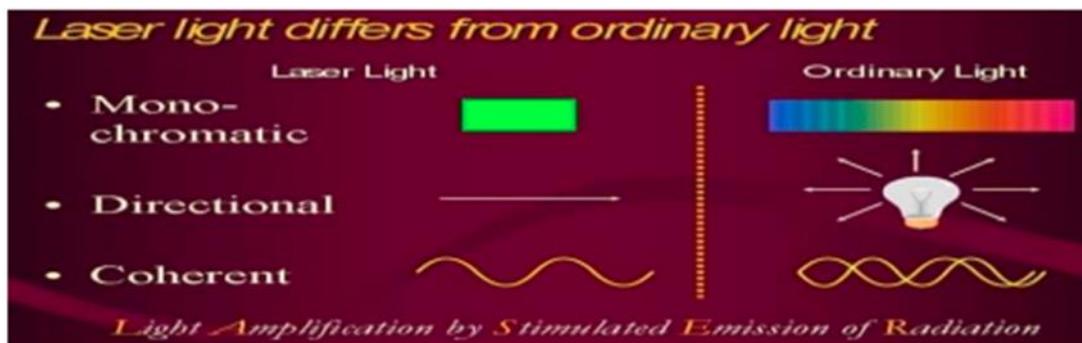




Before

After

Properties of Laser Light



Type of laser and wavelength in Dermatology

Generally as higher the wavelength, deeper the effect :

بشكل عام كلما زاد الطول الموجي ، كلما كان التأثير أعمق:

Type of Laser نوع أنسجة الطول الموجي بالليزر	Wavelength	Tissue
Argon laser ليزر الأرجون	488 nm	Thin vessels أوعية رقيقة
Alexandrite الكسندريت	755 nm	Hair removal, مزيل شعر،
Co2	10600 nm	Vaporization (surgery) التبخير (جراحة)
Nd:YAG	1064 nm	Deeper vessels سفن أعمق
Er:YAG	2940 NM	Peeling (ablative) تقشير

Types of Skin Lesions:

1-Pimples



2-Patches



3-Scars

4-Tumors



Adverse effects of Laser Treatments are Burns:

The following adverse effects may occur:

- Temporary Pain
- Redness
- blistering Bruising
- Crusting



Facial wrinkles, scars, and sun-damaged skin:

Facial laser resurfacing uses high-energy, pulsed and scanned lasers. Pulsed CO₂ and erbium:YAG lasers have been successful in reducing and removing facial wrinkles, acne scars and sun-damaged skin.

High-energy, pulsed, and scanned CO₂ laser is generally considered the gold standard against which all other facial rejuvenation systems are compared. Typically, a 50% improvement is found in patients receiving CO₂ laser treatment.

Side effects of treatment include postoperative:

- Scarring
- Swelling
- Redness
- Tenderness

The redness and tenderness last several weeks, while new skin grows over the area where the damaged skin has been removed by the laser treatments (ablative laser systems).

Secondary skin infection including reactivation of herpes is also a potential problem until healing occurs. Extreme caution is needed when treating darker skinned individuals as a permanent loss, or variable pigmentation may occur long term.

Absorption of light by Tissue

The term tissue is used to describe a group of cells that are similar in structure and perform a specific function.

The four primary tissue types:

1- Epithelial tissue: Refers to groups of cells that cover the exterior surfaces of the body, line internal cavities and passageways, and form certain glands.

2- Connective tissue: As its name implies, binds the cells and organs of the body together.

3- Muscle tissue: Contracts forcefully when excited, providing movement.

4- Nervous tissue: Is also excitable, allowing for the generation and propagation

of electrochemical signals in the form of nerve impulses that communicate between different regions of the body.

Transmission refers to the passage of light through a tissue without having any effect on that tissue or on the properties of the light.

Reflection refers to the repelling of light off the surface of the tissue without an entry into the tissue. Approximately 4% to 7% of light is reflected off skin. The amount of light reflected increases with increasing angle of incidence.

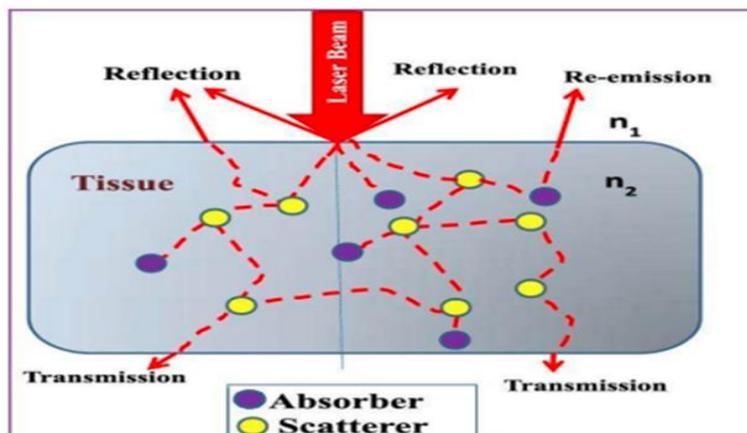
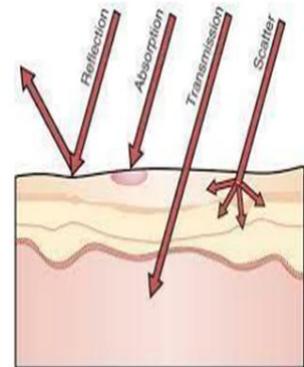
Laser – Tissue Interactions:

1- Transmission. الانتقال

2- Reflection. انعكاس

3- Scattering. نشر

4- Absorption. الامتصاص



Cooling Surface:

When the chromophore contained in the target for ablation, such as melanin in a hair follicle, is located deeper in the skin than unintended targets such as epidermal melanin, the selectivity of the laser for its intended target can also be improved by surface cooling. There are three principal delivery methods for surface cooling:

- 1- Precooling
- 2- Parallel cooling
- 3- Postcooling

Main Absorbing Components Chromophores by Tissue:

Each type of tissue has specific absorption characteristics depending on its

- Specific components - Hemoglobin - in blood.
- Melanin - air, skin
- Water - tissue biological all

Absorption on Affecting Factors

The following factors will each and collectively affect the absorption of laser light by a target tissue:

- 1- Laser wavelength.
- 2- Tissue (composition).
- 3- Tissue thickness.
- 4- Surface wetness.
- 5- Incident angle of beam.
- 6- Exposure time.

Benefits of Laser Tissue Interactions

From the above, a number of benefits of laser use in the treatment of soft and hard tissue can be listed as follows:

Benefits of Laser Tissue Interactions

From the above, a number of benefits of laser use in the treatment of soft and hard tissue can be listed as follows:

Soft Tissue:

- 1- Ability to cut, coagulate, ablate or vaporise target tissue elements.

- 2- Sealing of small blood vessels (dry field of surgery).
- 3- Sealing of small lymphatic vessels (reduced post-operative oedema).
- 4- Sterilising of tissue.
- 5- Decreased post-operative tissue shrinkage (decreased amount of scarring).

Hard Tissue:

- 1- Ability to selectively ablate carious dental tissue (faster ablation due to higher water content).
- 2- Reduced peri-operative cracking compared to rotary instrumentation.
- 3- pulpal Reduced temperature rise.
- 4- Cavity sterilisation .

Thermal Properties of Tissues:

The transport of thermal energy in living tissue is a complex process involving multiple phenomenological mechanisms including conduction, convection, radiation, metabolism, evaporation, and phase change.

Type of tissue	Thermal conductivity [$W \cdot m^{-1} \cdot K^{-1}$]	Thickness [mm]
Skull	0.32	7
Skin	0.37	1.5
Fat	0.21	4.5
Muscle	0.49	7.5
Blood	0.52	-
Cartilage	0.49	-