LASER IN MEDICINE.

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Abstract: Laser has become so popular in medical practice that this has led to the creation of laser medicine, which deals with issues related to surgery and cosmetic medicine. A high degree of qualification belongs to the medical laser center, which has the best laser equipment and experienced specialists.

Key words: laser, laser beam, ophthalmologists surgically, excimer lasers, laser energy, laser damage, ultraviolet pulses, thermal conductivity, long-pulse laser.

ЛАЗЕР В МЕДИЦИНЕ.

Аннотация: В медицинской практике лазер стал настолько популярным, что это стало причиной создания лазерной медицины, занимающейся вопросами, связанными с хирургией и косметической медициной. Высокая степень квалификации принадлежит медицинскому лазерному центру, обладающему лучшим лазерным оборудованием и опытными специалистами.

Ключевые слова: лазер, лазерный луч, офтальмологи, эксимерных лазеров, лазерной энергии, лазерное поражение, ультрафиолетовых импульсов, теплопроводности, длинноимпульсного лазера.

Laser-based instruments are widely used in medicine. They are used in cancer treatment, vocal cord tumor removal, brain surgery, plastic surgery, gynecology, and oncology. Laser therapy causes less bleeding and damage to healthy tissue than standard surgical instruments and reduces the risk of infection [1]. Surgical tissue

removal with a laser is a physical process similar to industrial laser drilling. Carbon dioxide lasers, which operate at a distance of 10.6 micrometers, can burn tissue because infrared rays are strongly absorbed by water, which makes up the bulk of living cells. The laser beam cauterizes cuts, stopping bleeding in blood-rich tissues such as the gums. Similarly, a laser with a wavelength of about one micrometer (a neodymium laser) can penetrate the eye, welding a detached retina back into place or cutting the inner membranes that often become cloudy after cataract surgery. Less intense laser pulses can destroy abnormal blood vessels that spread across the retina in patients with diabetes, delaying the blindness often associated with the disease. Ophthalmologists surgically correct vision defects by removing tissue from the cornea, reshaping the clear outer layer of the eye using intense ultraviolet pulses from excimer lasers [2]. Thus, delivering the right amount of laser energy of the right wavelength to the right tissue will damage or destroy only that tissue and nothing else. Ophthalmologists surgically correct vision defects by removing tissue from the cornea, reshaping the clear outer layer of the eye using intense ultraviolet pulses from excimer lasers [3,4]. However, if the laser beam hits non-target tissue, it can be dangerous and can cause damage to that tissue, especially to the eye (sometimes also to the skin), mainly because they can have high optical intensity even after propagating over relatively long distances [5]. Even when the intensity entering the eye is moderate, laser radiation can be focused by the eye's lens into a small spot on the retina, where it can cause severe, irreversible damage in a fraction of a second—even at power levels of only a few milliwatts. Laser damage to the eye is not always immediately noticeable: it is possible, for example, to burn the peripheral areas of the retina, causing blind spots that may not be noticeable until years later (Fig. 1).

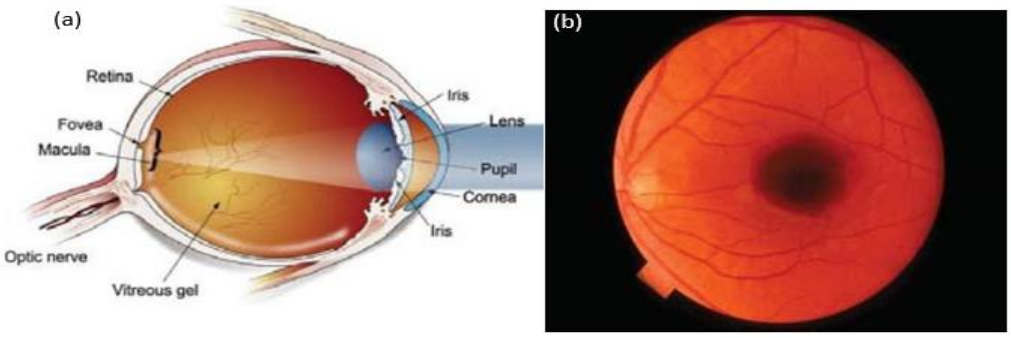

Fig. 1. (a) Simple diagram of the eye, (b) Retinal injury [9].

On the other hand, lasers can cause damage to the skin by causing photochemical or thermal burns. Depending on the wavelength, the beam can penetrate both the epidermis and the dermis. The epidermis is the outermost living layer of the skin. Far and middle ultraviolet (actinic ultraviolet) are absorbed by the epidermis. Sunburn (redness and blistering) can result from short-term exposure to the beam. Exposure to ultraviolet is also associated with an increased risk of skin cancer and premature aging (wrinkling, etc.) of the skin. The effect of a laser on tissue depends on the power density of the incident beam, tissue absorption at the incident wavelength (Figure 2), the residence time of the beam in the tissue, and the effects of blood circulation and thermal conductivity in the affected area [6].

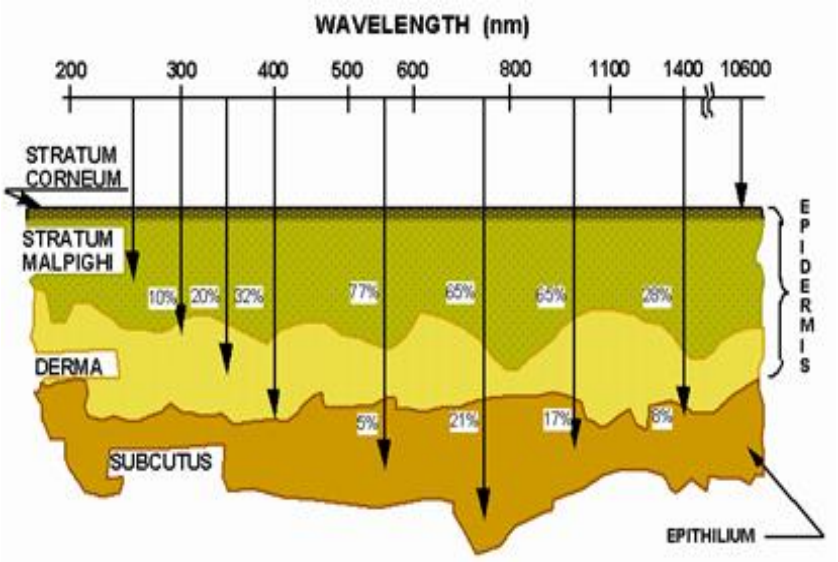

Fig. 2. Penetration of light waves of different lengths through the skin [10].

Proper control of the laser parameters mentioned above will lead to successful treatment of the target area, otherwise it will cause skin damage if not calculated. An example is the current work of our group on the assessment of skin temperature during laser therapy using long-pulsed Nd laser for the treatment of port wine stains (Fig. 3). Monitoring the skin temperature during therapy has been studied to prevent the skin temperature from increasing during therapy to an undesirable level that may cause skin damage, a cooling system has been used on the skin to reduce the thermal and pain effect during therapy.

The skin temperature without and with the cooling system is shown in Fig. 4. (a) and (b), respectively.

Fig. 3. Laser therapy of skin lesions.

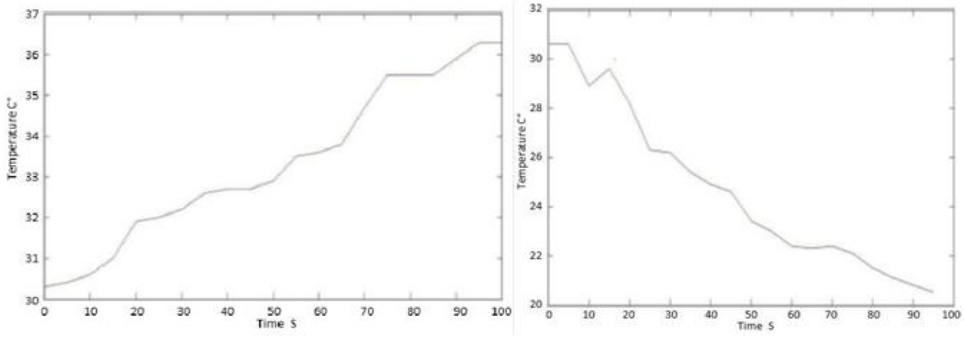

Рис. 4. Температура кожи при лазерной терапии, (а) без охлаждения, (б) с воздушным охлаждением.

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