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Lasers of various wavelengths are available for photocoagulation involving laser application in the macular area. The advantages of using lasers for photocoagulation are a smaller spot size as a result of optimum focalization and the theoretical, but rarely realized, benefit of a well-defined depth of activity of the monochromatic light, since the regions of maximum absorption within a tissue are determined by wavelength. Absorption is fundamental for the thermal coagulative effect in the target tissue. Short-wave blue laser light should not be used because it is absorbed by xanthophyll, possibly leading to severe retinal damage.

Meyer-Schwickerath performed the first retinal photocoagulation procedure, focusing natural sun rays. Problems with dependency on weather conditions, the position of the sun, as well as varying intensity and limitations in obtaining narrow, highly intensive light beams quickly led to the use of artificial light sources. So-called arc lamps provided very bright and easily focusable light that was constantly available. The emission spectrum required for photocoagulation was readily obtained by regulating the composition, pressure and temperature of the gas. The xenon-light coagulator was widely used for panretinal treatments, induction of chorioretinal adhesions and retinal vascular obliteration.

The introduction of laser technology further improved the potential of photocoagulation, allowing ideal focusing of the emitted rays due to their spatial coherence and the ability to adapt exactly the monochromatic light to the absorption properties of the target tissue in order to optimize focal coagulation.

Laser technology therefore provided the ideal requirements for the application of photocoagulation in the macular area, as in the treatment of choroidal neovascularization (CNV) in age-related macular degeneration (AMD), for example.

Laser beams interact with tissue in several different ways. The light energy is absorbed and emitted as fluorescent light or converted into heat. The conversion into thermal energy is the basis of any therapeutic photocoagulation. Modest temperature rises, such as seen in transpupillary thermotherapy for CNV (10 °C), do not produce thermally induced necrosis. Coagulation of tissue requires a more dramatic temperature rise, typically 80°C. On the other hand, the electromagnetic field of a highly energetic laser beam can interact with the electrons of hit molecules and cause the liberation of electrons and ionization processes in the target tissue. The ionizing effect is used for photodisruption in capsulotomy or iridotomy. The Nd-YAG laser, with a wavelength of 1.064 μm, is an example of this technique. Photodynamic therapy, such as that done with verteporfin for neovascular forms of AMD, uses light activation of a photosensitizing molecule. This raises the energy state of the molecule. This energy can be transferred to oxygen, yielding singlet oxygen. The singlet oxygen is more reactive than regular oxygen and through a variety of reactions can cause oxidative damage. Sufficient accumulation of the sensitizer within the target tissue may, for example, lead to vascular obliteration while sparing adjacent normal tissue and avoiding substantial thermal destruction. Since transpupillary thermotherapy, photodisruption, and photodynamic therapy are not photocoagulation per se, the term photocoagulation should be reserved for laser treatments causing thermally induced necrosis.

An essential requirement for photocoagulation is the absorption of laser beams within the target tissue. The various tissue layers of the human eye absorb different wavelengths; the choice of wavelength thus influences the precise thermal effect within the target tissue and the side effects within adjacent tissues. Often, however, when photocoagulation is performed, the end result is a generic, white, fairly non-specific thermally induced necrosis. The depth of penetration of the laser light used for photocoagulation through the ocular media into the layers of the retina, the pigment epithelium and the choroid increases with the wavelength used. While short-wave blue light (e.g., argon blue) is easily scattered by turbid ocular media and is already partly absorbed by the macular xanthophyll of the retina, causing severe retinal damage, red laser light (e.g., krypton red laser) penetrates even mildly turbid ocular media without substantial scattering. It also passes through thin layers of blood and deeply into the choroid, as it is hardly absorbed by hemoglobin. Much of the absorption occurs in melanin, so a sufficient concentration of melanin within or near the target tissue is essential for photocoagulation with this wavelength.

For most retinal laser photocoagulation, green light (as in the common argon laser) is sufficient,