Absorption and light scatter are just two of the considerations in the delicate relationship between laser and tissue that determine the suitability of a wavelength to a particular ophthalmic procedure. For instance, the most effective wavelengths for macular photocoagulation are those that are poorly absorbed by macular xanthophyll and well absorbed by melanin in the retinal pigment epithelium (RPE) and choroid, as well as hemoglobin. Thus, the selection of the best wavelength for treatment of the macula is a function of the differing light scattering and light absorption properties of the various wavelengths. As a result, use of both the yellow wavelength (561-577nm) and the red wavelength (659-670nm) to perform retinal treatment warrants further investigation.
tissues than the green wavelength,” says Dr. Fekrat.

Professor Michael Stur, University of Vienna, Austria, agrees. “I have been using the yellow wavelength for many years, and I would agree that it is a very good wavelength for retinal laser photocoagulation. Its main advantage is its high absorption in melanin and hemoglobin, which produces visible lesions with low energy settings. I would not call this “gentle”, although it is possible to make very low intensity burns with yellow.”

The factors that determine whether a patient experiences pain during retinal laser treatment are power, the laser wavelength absorption and the pulse length or duration. “The use of the yellow wavelength is more comfortable for patients because there is less lateral as well as less axial spread of thermal energy. Because the yellow wavelength is well absorbed, the power and duration can be decreased and thus the patient is more comfortable,” explains Dr. Fekrat.

“The main advantage of the yellow wavelength is that yellow is taken up in oxygenated and deoxygenated blood more preferentially than the green wavelength. This means that when we are treating a blood vessel, the yellow wavelength is taken up and it thus requires less energy to affect the vessel without inflicting damage on surrounding tissues,” adds Dr. Dyer.

An advantage when treating inside the macular pigment area is that the 561nm yellow wavelength is less absorbed by xanthophyll, says Dr. Dyer. As a result, use of the yellow wavelength may be safer to use when treating microaneurysms or choroidal neovascularization in the peri and parafoveal region. Dr. Fekrat concurs that higher absorption by melanin and hemoglobin and an absence of xanthophyll absorption are important features of 561nm yellow. “High absorption by hemoglobin allows selective treatment of diabetic microaneurysms, and high absorption by melanin is preferred during laser trabeculoplasty (ALT) and peripheral iridotomy,” explains Dr. Fekrat.

The yellow wavelength is also an excellent choice to close vessels, such as aneurysms. “Because the 561nm yellow wavelength is absorbed by hemoglobin it is better absorbed
The Yellow Wavelength: High-Power Minus Collateral Damage

561nm vs. 577nm

Both Dr. Dyer and Dr. Fekrat agree that the two solid-state yellow wavelength technologies available in the marketplace today -- 561nm and 577nm – are comparable, and that based on absorption coefficient charts, clinical differences between the wavelengths and their interactions with various retinal tissues, one can expect similar clinical results and benefits with either yellow wavelength.

561nm does have marginally higher absorption in melanin than 577nm yellow, however, which makes it better suited to standard photocoagulation treatments targeting the RPE. Both 561nm and 577nm are equally efficacious for treatments in and around the macula given that they share the same absorption profile in xanthophyll.

than the 532nm green wavelength by microaneurysms in eyes with clinically significant macular edema due to diabetic retinopathy,” says Dr. Fekrat. “The yellow is also ideal to treat hemangiomas, which are vascular and thus contain high levels of hemoglobin,” she adds.

The yellow wavelength produces less scatter and thus allows better transmission through lens opacities. In particular, yellow can be used effectively to transmit through lenses with nuclear cataracts. According to Professor Stur, this is a key advantage of 561nm over 532nm. “The significantly reduced scatter of 561nm through lenses with nuclear cataracts allows us to use reduced power settings, but still have enough power to treat the retina."

“Since lens opacities scatter the laser beam, using a wavelength that allows less scatter will, by definition, be more effective in such clinical scenarios,” explains Dr. Fekrat. “Like colors go through like colors,” adds Dr. Dyer, “so using the yellow wavelength is beneficial for maintaining sufficient power to penetrate a nuclear sclerotic cataract without inflicting damage to the lens.”

Ultimately, Dr. Fekrat says, in addition to its other benefits, the yellow wavelength is ideal for treating clinically significant diabetic macular edema and juxtafoveal and extrafoveal choroidal neovascularization, as well as to perform grid pattern laser in eyes with branch retinal vein occlusion. “Also, given its high absorption in melanin, the yellow laser may be considered in the treatment of some eyes with chronic central serous retinopathy because the lack of yellow laser uptake by xanthophyll protects the fovea,” says Dr. Fekrat. And finally, she adds, this versatile wavelength “may also be better suited for feeder laser photocoagulation in eyes with retinal angiomatous proliferans.”

REFERENCES