

New solid-state lasers show potential advantages over excimer lasers

Roibeard O'hEineachain
in Rome

THIS year's ESCRS Winter Refractive Surgery Meeting will include reports of results of LASIK and PRK using two new non-excimer solid-state lasers, the Lasersoft (Katana Technologies GmbH) and the Pulzar™ Z1 (CustomVis) (Friday, February 4, Corneal Remodelling For Refractive Surgery I 17:00-19:00).

Solid state lasers have several potential advantages over currently available excimer laser systems said Matteo Piovella MD, Monza, Italy, who will be presenting one-year results with the Lasersoft laser at the meeting.

For example, they do not require the use of toxic excimer gases and also provide better pulse-to-pulse stability of the energy due to the cw-diode pumping of the primary laser. They can also use beams with a wavelength closer to the absorption peak of corneal collagen, which therefore reduces harmful thermal effects and collateral damage, he told *EuroTimes*.

The Lasersoft is a tuneable short-pulse, 210 nm wavelength, Q-switched, diode-pumped laser with a 0.25 mm flying spot and an ablation zone variable from 1.0 to 10.0 mm. The laser system is also fitted with an eye tracker working at a speed of more than 1 kHz with a latency of 1 millisecond, Dr Piovella noted.

"Its wavelength is not absorbed in air, water or tear fluid, thus the ablation process is less sensitive to humidity in the surgery room, no purging with inert gases is necessary, and even if the stromal bed is wet the ablation rate remains stable."

Early refractive stability after surface ablations

In a study involving 37 eyes of 37 patients with a mean spherical equivalent of -1.71 D who underwent LASIK with the new laser to correct a mean refractive error of -3.3 D, the mean postoperative refraction at one month's follow-up was -0.2 D. In addition, mean uncorrected visual acuity was 0.75. Furthermore, there were no postoperative complications and all eyes reached refractive stability within one month and thereafter had no significant variation in refraction, Dr Piovella noted.

"Its ablation pattern overlaps the true Gaussian spots, ensuring an extremely homogenous corneal surface. Thanks to its very small spot size, Lasersoft may well fit the present requirement for custom ablation. It applies less energy to the cornea, and the theoretical speculation that this feature leads to less scarring is apparently confirmed by our one-year results."

In another Italian study to be presented at the congress, the laser appeared to produce very promising results in surface ablations for both hyperopia and myopia with or without astigmatism.

The study included 140 eyes of 80 patients, of whom 107 were myopes, 27 were hyperopes and six had mixed astigmatism. All underwent PRK with the Lasersoft laser, said Marco Rossi MD, Busto Arsizio, Italy.

At one-and-a-half month's follow-up 95.64% of eyes had a UCVA of 0.5 or better and that increased to 98.08 % after six months. Furthermore, while the percentage with a preoperative BCVA of 1.0 or better was only 59.42%, the percentage rose to 73.33% after one-and-a-half months, and to 94.23% after six months. In addition, 16.09% of eyes gained one line of BCVA after three months.

"In this winter ESCRS meeting we will present the one- and-a-half year follow-up of the same group, and the overall results of a greater cohort of more than 350 eyes," Dr Rossi told *EuroTimes*.

He noted that evaluation of the corneas the day after surgery showed a normal re-epithelialisation speed and very homogeneous and transparent corneal surfaces, short pain and short inflammatory signs. No eyes had haze.

"Solid-state diode pumped laser LaserSoft presents a small spot diameter with a true Gaussian beam shape, which permits us to obtain a smooth surface and opens the way to the correction of higher-order aberrations by customised ablation. Clinical data of patient treatments showed the efficacy and safety of the refractive procedure."

Less haze and inflammation

Further evidence of the safety benefits of the solid state laser will be presented by Dr Rossi's associate, Paolo Garimoldi MD. His findings indicate not only that the Lasersoft laser applies less heat to the cornea than excimer lasers, but also that it induces less inflammation and haze when used for surface ablations.

A study which compared the results involved 64 eyes of 34 patients who underwent PRK with the LaserSoft or Zeiss Meditec Mel 70. Thermocamera measurements showed that the temperature increase during treatment was only 0.8°C in eye treated with diode pumped solid state laser, compared with 5.3°C in eyes treated with excimer laser.

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Matteo Piovella MD

In addition, confocal microscopy showed less damage of upper corneal stroma just after treatment and less inflammatory signs (less haze thickness and reflectivity on confocal microscopy), after one and three months in eyes treated with a solid state laser. Differences tended to decrease after three months. Corneal haze was less severe and visual recovery was faster in eyes treated with the diode laser, Dr Garimoldi said.



Ian Anderson



Marco Rossi



Matteo Piovella

Results with CustomVis

Results with the other solid state laser the CustomVis Pulzar™ Z1 will be presented at the Rome meeting by Ian Anderson MD, Claremont Eye Clinic, Australia.

The Pulzar™ Z1 refractive solid state laser system has been designed to perform custom ablations, as well as standard treatments. It utilises a 213 nm laser beam of 0.6 mm scanning spot size, with the fast pulse rate of 300-400 Hz allowing quick ablations. The solid state technology also allows superior laser beam scanning; significantly faster than the Galvanometer based systems. The Pulzar Z1 combines refractive and topographic data to create the customised treatment plan for each patient, Dr Anderson said.

In a multicentre study, 62 eyes with a manifest refraction spherical equivalent less than -5.0 D and astigmatism up to -4.00 D underwent customised ablations with the Pulzar™ Z1 laser. The postoperative MRSE was ± 0.5 D from target in 70% of cases, and 92% were within ± 1.0 D.

Furthermore, 90% achieved unaided vision of 6/7.5 or better and 100% were 6/12 or better. In addition, at one site six LASEK cases were performed; all achieved unaided vision equal to their pre-operative aided vision.

Dr Anderson has also used the solid state Pulzar Z1 to custom treat eyes with severe visual anomalies. He told *EuroTimes* that he has achieved dramatic initial results with patients who had highly irregular corneas and severe irregular astigmatism following either penetrating keratoplasty or photorefractive keratectomy. Corrections were between +5.25 D to -3.0 D sphere and up to -9.0 D of astigmatism. Of the 12 cases, UCVA improved in nine eyes, by up to five lines, and keratometric cylinder decreased by as much as 9.0 D.

"The solid state Pulzar™ Z1 laser with its 213 nm wavelength represents a very suitable option for customised refractive surgery."

In addition, in extensive scientific experiments performed in collaboration with the University of Western Australia, histological observations show that the solid state 213 nm wavelength produces smooth, clean corneal ablations with no evidence of thermal damage. Absorption studies demonstrate that 213 nm is significantly less absorbed in 0.9% NaCl and water in comparison to the excimer 193 nm, thus fluctuations in hydration or humidity are unlikely to have a significant effect on 213 nm ablation performance.

"The Pulzar™ Z1 has combined the advantages of solid state technology with an effective custom-ablation platform; this system could possibly be the next generation in refractive surgery."