Solid-state laser providing impressive outcomes in myopia and myopic astigmatism

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in London

Refractive surgeons investigating the 213-nm Pulzar Z1 solid-state refractive laser (CustomVis) are enthusiastic about the potential advantages of this technology and report favourable safety, predictability, and effectiveness outcomes in eyes treated for low to high myopia with or without astigmatism.

At the XXIV Congress of the ESCRS, Gabriel E Marin MD, Clinica Medellin Poblao, Medellin, Colombia, presented results from 295 eyes enrolled in an international, multicentre study investigating Pulzar Z1 LASIK for low to moderate myopia with or without astigmatism. Dr Marin’s fellow investigators in that study are Ioannis Pallikaris MD, Institute of Vision and Optics, University of Crete, Greece and Marc Tay MD, Laski Surgery Clinic, Singapore.

The 295 eyes in the series reported by Dr Marin had pre-operative manifest refraction values ranging from -0.5 D to -6.0 D and astigmatism up to -5.0 D. The cohort had 100 per cent follow-up to three months, when the mean postoperative SE was -0.19 D. At that visit, the predictability analysis showed 221 eyes (75 per cent) were within 0.5 D of targeted refraction and 280 eyes (95 per cent) were within 1.0 D of their intended correction.

These results well exceed the FDA benchmarks for refractive surgery that require only 50 per cent of eyes to be within 0.5 D of intended correction and 75 per cent to be within 1.0 D. The treatment accuracy translated into excellent vision outcomes. Uncorrected VA was 20/20 or better in 398 eyes (67 per cent), 274 eyes (93 per cent) achieved UCVA of 20/25 or better, and 98 per cent were 20/40 or better. Best spectacle corrected VA was improved by one line in 109 eyes (37 per cent) and remained unchanged in 148 eyes (50 per cent).

The study group reported data collected in 349 eyes with low-to-moderate myopia and myopic astigmatism that underwent Pulzar Z1 treatment with LASIK, LASEK, or PRK. In addition, he presented early results from 71 eyes treated with LASIK for higher levels of myopia (range, -6.0 to -17.0 D) with and without astigmatism.

More than 400 eyes have been treated for myopia or myopic astigmatism up to -6.0 D, but the 349 eyes he reported had been followed for at least one to three months. No eyes in that series lost more than one line of BSCVA, nearly all were corrected to within 1.0 D of intended refraction and the predictability rate within 0.5 D was also extremely high.

The scattergram for the predictability revealed that 86 per cent of eyes were within 0.50 D of intended refraction at one month, and at three months, that outcome was achieved in 98 per cent of eyes.

At last available follow-up, UCVA was 20/40 or better in 89 per cent of treated eyes, and the refractive outcome was within 0.5 D of intended in 68 per cent of eyes and within 1.0 D of the intended target in 94 per cent.

Good results with high myopia

“The scattergram for these eyes is also very impressive and demonstrates no tendency for undercorrection of the very high myopes that is common with some excimer laser treatments. The study group also described the features of the solid-state Pulzar Z1 laser and highlighted that it is technology designed to assure safe, accurate, and efficient conventional and customised treatments while offering many practical advantages for the user.

The Pulzar Z1 uses a diode-pumped Nd:YAG laser as its energy source, but the 1034-nm infrared beam of that device is quadrupled and converted to the 213-nm as it passes through three nonlinear crystals.

“This solid-state technology eliminates the need for gases and tanks, is very energy efficient without any special voltage requirements, and improves the pulse to pulse energy stability,” said Dr Marin.

With the use of the Nd:YAG crystals as the energy source, the system needs less optics to shape the pulse, and it also avoids the potential risks associated with using toxic and corrosive gases. Furthermore, this solid-state laser is less expensive to operate and maintain.

The 213-nm wavelength itself has advantages compared with the 193-nm wavelength of the excimer laser as it is closer to the absorption peak of corneal collagen, has higher transmission through water, saline, or BSS, and has a minimal thermal effect on the cornea, resulting in less collateral damage.

“This ablation produces more exudation than we are accustomed to seeing with the excimer laser, but there is no need for hydration monitoring during the procedure, and the ablated surface is cleaner and smoother than that achieved after excimer laser treatment,” Dr Marin said.

The laser also features a fast pulse rate (300-400 Hz) and 0.6mm Gaussian shaped flying spot that ensures a rapid treatment time and enables precise, smooth ablations using either standard or customised profiles.

Theoretical studies have shown beam size is important for customised laser refractive surgery. With a 2.0mm beam, the solid-state laser should enable correction of sixth order Zernike modes, Dr Marin said.

This laser offers an improved beam quality and shape and can also be used to create an ablation zone measuring up to 10.0mm in diameter including the blend zone.

The Pulzar Z1 also uses two different eye-tracking systems, one that monitors intraoperative gaze (GAZETRAK) and the other that is a limbal based, 1 kHz closed loop system (ZTRAK), which does not require pupil dilation. The laser platform also incorporates technology to determine if there is any cyclorotation/cyclotorsion when the patient moves from an upright position pre-operatively to supine on the treatment table, and uses that information to register the surgical plan 1:1 with corneal position.

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