Refraction optimized by adjusting laser nomograms

By LYNDA CHARTERS
Reviewed by Noel Alpins, MD

MELBOURNE, AUSTRALIA—Superior visual outcomes can be achieved for laser refractive surgery by dealing separately with the variables used, according to Noel Alpins, MD.

For patients undergoing excimer laser surgery to correct myopia, hyperopia, and astigmatism, a minimum of six variables are computed.

These include the spherical equivalent target, astigmatism optimization, hyperopic spherical shift to treat myopic astigmatism, and adjustment for any existing spherical and astigmatic under- or overcorrection.

Dr. Alpins explained the manner in which he adjusted the original nomograms of the Nidek EC5000 using the ASSORT software to maximize the outcomes in 204 patients who underwent PRK and photoastigmatic refractive keratectomy (PARK).

Dr. Alpins, who is medical director of NewVision Clinics, Melbourne, Australia, presented his results at the 24th annual meeting of the American Society of Cataract and Refractive Surgery.

"The ASSORT software looks initially at the spectacle plane to corneal plane conversion that in most cases can be done by the excimer laser-controlling software," Dr. Alpins said. "We set this parameter on the laser to a back vertex distance of 0 mm.

"Then the spherical equivalent target must be specified. In this study, all patients had targets of zero for emmetropia, but the option is there to leave a small refractive error such as myopia for monocular near vision.

"For our patients, we optimized the results according to refraction and topography values and included the topography in the surgical plan.

"The actual astigmatism treatment lay between the refractive treatment and the topographic treatment for a spherical result. By giving more emphasis to topography in the planning process, less astigmatism would remain on the cornea after surgery than if refractive astigmatism alone was considered," he said.

He said other variables must be addressed.

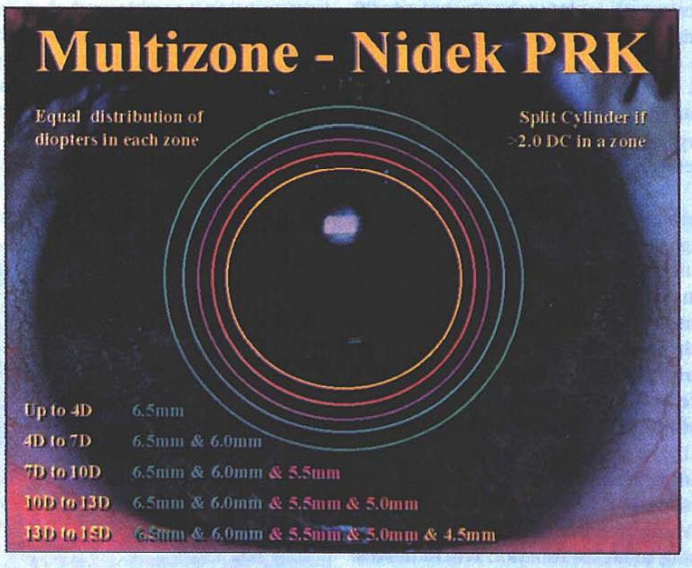
"When myopic astigmatism is treated, a hyperopic shift occurs. We have allowed a factor to reduce the spherical myopic treatment to avoid overcorrection.

"In addition, any over- or undercorrection of spherical correction on the part of the laser must be accounted for and any undercorrection of the astigmatism must be considered. Such an adjustment to the nomogram can markedly change the numerical values programmed into the laser.

"As an example, instead of the refractive value at the corneal plane of −1.95 D for spherical correction, −2.31 D for astigmatic correction at axis 40°, the treatment value used was −1.39 D spherical correction, −2.51 D cylinder at axis 35°," he said.

He also described deviating from the laser manufacturer's recommendations by using a multizone technique, rather than a single zone where the diameter of the ablation zones shrinks as the degree of myopia increases. This technique reduces avoidable ablation depth, but maintains the maximum ablation zone diameter.

"Up to 4 D, we use a 6.5-mm zone, from 4 to 7 D we use a 6.5- and a 6-mm zone with an equal distribution of diopters in each zone," he said.



A multizone technique reduces avoidable ablation depth, but maintains the maximum ablation zone diameter. (Photo courtesy of Noel Alpins, MD)

As the myopia increased up to 15 D, Dr. Alpins used up to five ablation zones. In patients outside this study who underwent LASIK, no variation in the treatment for the PRK study has been shown to be necessary.

PRK versus PARK

A total of 204 eyes underwent treatment in patients with myopia that ranged from −0.75 to −15.25 D. Equal numbers of patients were preoperatively assigned to undergo surgery with PRK or PARK. About 75% of patients had myopia that ranged from 0 to 5 D.

The refraction results at 6 months postoperatively in those patients were within ±1 D of emmetropia in 96% of patients who underwent PRK and 98% of those who underwent PARK; 100% of patients were within ±2.0 D of emmetropia using both techniques, he said.

An uncorrected visual acuity level of 20/20 or better was achieved in 61% of patients who underwent PRK and 67% of those who underwent PARK; 20/40 or better uncorrected vision was achieved in 96% and 95%. The mean spherical equivalent for the two groups at 6 months was very close to zero, and the mean values achieved were −0.23 D for the PRK group and virtually zero for the PARK group.

"Because of undercorrection of sphere, we found that for the second subsequent group we wanted to increase the correction for myopia by 5% in the PRK group," Dr. Alpins explained after analyzing the data from the first group of patients who underwent treatment.

"After an additional 3 months of follow-up of that group, we have successfully achieved a full 100% myopic correction," Dr. Alpins said. "To avoid overcorrection in the PARK patients who already had the full correction of their spherical equivalent myopia, we increased the allowance for the hyperopic shift of the myopic astigmatism correction and in that way did not increase the spherical correction."

In patients who underwent PARK, a full correction of the astigmatism was sought by adjusting the treatment upward by 30% greater than the cylindrical value to be corrected.

"The interesting point is that even though another 10% correction was added for the second subsequent group we could not get more effect than the 80% to 90% astigmatism correction

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looking at it by keratometry and refraction. This was the same as for the initial group's treatment. There seems to be a limit to how much adjustment can be made for undercorrection."

"With the aid of the appropriate software, we can refine our treatment nomograms by separately treating and analyzing our adjustable factors, particularly the sphere, the cylinder, and the hyperopic shift of the cylinder with defined spherical and astigmatic targets," Dr. Alpins stressed.