



Sven Lee

New aspheric profiles improve presbyopia and night vision problems

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EVIDENCE suggests that high myopia and presbyopia can be treated successfully by designing new-individual-aspheric-ablation-profiles, using a modification of Zernicke polynomials based upon empirical aberrometry analyses.

“Customised correction of spherical aberrations improves contrast sensitivity, mesopic contrast sensitivity and especially near vision and reduces presbyopia in myopic, hyperopic and even high myopic and hyperopic cases. Eyes that we treated with high myopia, hyperopia, and astigmatism show no significant differences at all one year after surgery,” said Sven Lee MD at the annual ESCRS Congress. He conducted the study in association with the ASA80 Laser Clinics, Nürnberg, Germany and the GM Eye Clinics, Seoul, South Korea.

Dr Lee conducted the prospective multicentre clinical trial that aimed to design a pupil dependent refraction for the improvement of night vision problems and presbyopia from 1/2006 to 2/2007. The investigation included 43 eyes of 26 consecutive patients. The patients were myopic, highly myopic (-9 to -15 D), hyperopic, highly hyperopic (up to +4.5 D), highly astigmatic (up to -7.00 D), and emmetropic. Dr Lee used the new ablation profile in all cases, with the spot-scanning laser MEL 80 (Carl Zeiss Meditec).

The mean preoperative spherical equivalent for the myopic eyes was -6.32 ± 2.65 D, ranging from -0.75 to -14.75 ± 2.65 D. The preoperative spherical equivalent for hyperopic eyes was $+2.49 \pm 1.45$ D, ranging from +0.75 to +4.5 D. The mean add requirement was $+1.98 \pm 0.41$ D.

Contrast sensitivity, under daylight and mesopic conditions, evaluated with CSV 1000 (Vector Vision), revealed that low contrast visual acuity was significantly better postoperatively compared to preoperatively with the nine per cent test face, and unchanged (not decreased) with the six per cent test face. Overall, these parameters were significantly better than preoperatively, he said.

There was a full recovery of contrast sensitivity within three months. After one year, the results were significantly better than preoperatively. Dr Lee observed a similar trend in mean normalised mesopic contrast sensitivity after one year. There was no statistically significant change in glare vision at one year, Dr Lee said.

When comparing high myopic/high hyperopic with normal myopic/normal hyperopic cases, Dr Lee found no changes in contrast sensitivity, after one year, between these two groups. He noted a

difference, however, with regard to mesopic contrast sensitivity, showing that the results using the new profiles were significantly better postoperatively at one-year follow-up.

Two eyes lost more than two lines of best-corrected visual acuity under daylight conditions due to haze – this was an effect of having performed PRK, not of the new aspheric profiles themselves, said Dr Lee.

“The perfect design of an ablation profile with a positive spherical aberration for presbyopic eyes should include an increase depth of focus for far vision, set bright light refraction below plano (around -0.75 D), avoid inducing night myopia, and have mesopic refraction around plano”

Sven Lee MD

The key to the new ablation profile is that the refraction of the eye becomes slightly more myopic as the pupil enlarges, and is plano under daylight conditions.

There was an overall average gain of 4.5 lines for near visual acuity. Reading ability improved from Niden 7 to Niden 2 on average in the study eyes, after one year. Night vision improved in almost 94 per cent of the cases. He did not find any significant differences in the results obtained in high myopic, high hyperopic, or astigmatic eyes.

Dr Lee evaluated the depth of focus and the influence of pupil diameter on the results as well as on the control of refraction. Dr Lee reviewed some of the less optimal results also. In one case example, the advanced ablation profile had good visual results under bright lights, but got myopic and had some problems with night myopia under mesopic conditions. In another case example, an eye was overcorrected (hyperopic) under bright daylight and mesopic conditions. Another patient was undercorrected (myopic) under bright daylight and mesopic conditions. Finally, one case example was somewhat myopic under bright daylight, with good far and near vision, and plano under mesopic conditions. This patient seemed to have the perfect outcome, with no trouble with night vision, Dr Lee noted.

Looking at the depth of field for far vision of the two groups, he found out that with the Z4(0) the depth of field was increased far more than with the standard aspheric ablation profile of the MEL80.

Details of new ablation profile

The MEL 80 has two ablation profiles:

tissue saving ablation (TSA), which is a Mummerlyn-type profile with k-value compensation, and aberration smart ablation, which is TSA plus a strong aspheric component. Dr Lee created a new individual aspheric profile, which is ASA plus Z (4.0), i.e. the addition of a positive spherical aberration (OSA notation).

He explained that Zernicke polynomials, especially Z (4.0), strongly increase under mesopic conditions after excimer laser surgery, which could be the reason for postoperative night vision problems. That is why he considers Zernicke polynomials not only as fixed values for the maximum pupil size but also as variable values in accordance with different pupil sizes.

Session moderator, Dan Reinstein MD, London Vision Clinic, London, UK, commented on Dr Lee's study.

“One of the big differences then between what you are doing and the VISX approach that we have seen presented, is that you are not specifically inducing a multifocal cornea with two corneal zonal focal points – one far and one near. You have a continuous variable so that as the pupil changes, the effective refraction of the eye shifts. Does that mean that when under very bright light conditions where the pupil might be small, the spherical aberration would imply that the patient is myopic, but because of the depth of field the distance vision is still good?”

“Yes, absolutely, by designing new individual aspheric ablation profiles, the clinical effectiveness on vision problems and presbyopia is improved. The perfect design of an ablation profile with a positive spherical aberration for presbyopic eyes should include an increase depth of focus for far vision, set bright light refraction below plano (around -0.75 D), avoid inducing night myopia, and have mesopic refraction around plano,” Dr Lee said.

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