PROLATE ABLATION

Overall HOA, visual quality, similar to aspheric LASIK in contralateral study

by Howard Larkin in San Diego

An optimised prolate ablation (OPA) profile significantly reduced spherical aberration in LASIK treatments both absolutely and compared with a more-standard optimised aspheric transition zone (OATz) ablation in fellow eyes in a prospective contralateral study of myopia and myopic astigmatism correction, reported Arturo S Chayet MD, at the 2011 ASCRS annual meeting.

Even so, total higher order aberration values were similar, and there was no statistically significant difference in measures of vision quality, including corrected and uncorrected acuity, contrast sensitivity and subjective patient responses at six months after surgery. Refraction stability and safety also were comparable, he noted.

"Refractive outcomes are excellent for both ablation profiles. There was better objective visual quality and no loss of contrast sensitivity in either group," said Dr Chayet, director of the Codet Aris Laser Vision Institute in Tijuana, Mexico.

While reduced spherical aberrations might be expected to produce better outcomes, particularly given its effect on central vision, Dr Chayet noted that the OPA-treated eyes also showed greater coma, which also affects central vision and may have offset this potential advantage.

"The main conclusion seems to be that OPA, because of the prolate nature of the treatment, is due to be used in presbyopic populations," said Dr Chayet, who is an investigator for NIDEK, which developed both profiles.

**Induced higher-order aberrations**

The OATz algorithm and other approaches were developed in the early 2000s following the realisation that conventional LASIK and other laser refractive procedures induced higher-order aberrations that increased glare, haloes and other dysphotopsia even as they corrected lower order sphere and cylinder. These aberrations were thought to result largely from central islands, and abrupt transitions in peripheral treatment areas. OATz was designed to compensate by removing spherical aberrations in the central optical zone and aspherical aberrations in the peripheral transition zone by creating an overall aspheric corneal profile. Its success in improving visual outcomes has made it a more-or-less standard treatment for previously unoperated eyes without asymmetric astigmatism or other major irregularities, Dr Chayet noted.

However, laser refractive procedures on myopes also tend to increase spherical aberration across the cornea because they tend to flatten the centre and steepen the periphery. This increases positive Q-values and shifts the surface towards an oblate profile. The effect may have been amplified by calibrating lasers on flat, rather than curved, surfaces. When applied on the curved surface, the resulting ablation algorithms did not adequately compensate for peripheral reductions in surface fluence due to the increasing laser reflectance and treatment area as the laser intersected the cornea at increasingly oblique angles. As a result, less tissue was ablated peripherally than predicted.

This oblate anterior corneal profile becomes increasingly troublesome as patients age. As the crystalline lens thickens, it progressively loses the negative asphericity that usually offsets positive corneal Q in youth. As total positive Q increases, so does spherical aberration, reducing contrast sensitivity and increasing glare and haloes, especially under mesopic conditions.

The OPA ablation profile was developed to address this problem. It is designed to preserve the natural prolate profile to the anterior cornea, imparting a negative Q value that offsets the combined negative value of the posterior cornea and crystalline lens, or even over-corrects it anticipating the progressive positive shift. For this reason, older patients may be targeted with a more prolate, or negative Q, corneal profile, though achieving this requires ablation of more stromal tissue than a standard treatment.

Centred on the visual axis, the OPA treatment also must cover the entire pupil to alleviate night-time visual problems, Dr Chayet said.

Dr Chayet studied 28 patients with myopia ranging from 0.75 to 7.0 D and up to 3.0 D astigmatism, randomly assigning one eye to OPA and the other to OATz. Patients were evaluated for corrected and uncorrected visual acuity, contrast sensitivity, wavefront and satisfaction at one day, one week, one month, three months and six months after surgery.

While there were no statistically significant differences in visual outcomes at six months, the OATz group performed slightly better in most categories. With 94 per cent of eyes within 0.5 D of attempted mean refractive spherical equivalent, OATz results were slightly more predictable than the OPA group, which achieved 88 per cent and showed a slight trend towards undercorrection. Refractive stability was nearly identical in both groups, as was safety, though 55 per cent of OATz eyes gained one or more lines of best corrected vision compared with 36 per cent for OPA. Conversely, only one OATz eye, or three per cent, lost one line of vision compared with two, or five per cent, in the OPA group, though none of these differences were statistically significant.

Contact: Arturo S Chayet - arturo.chayet@codevision.com