The influences of reference plane and direction of measurement on eye aberration measurement

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Corneal flattening following myopic corneal ablation causes a reduction in magnification between aperture stop (iris) and entrance pupil.

Custom ablation based on pre-operative wavefront ablation across the entrance pupil will result in an incomplete correction.
Related Issues

- Does the direction in which aberrations are measured affect these measurements ie into-the-eye (Tracey) versus out-of-the-eye (Hartmann-Shack)?

- What is the effect of the reference plane on these measurements eg cornea versus entrance pupil?

- How do these effects vary with the level of myopia or when myopia is corrected?
Method

- Eye modelling using axial ametropic eyes based on Navarro model eye. Reference height 3mm (6mm diameter)
- Rigorous raytracing with wave aberrations referenced to either the anterior corneal plane or natural entrance pupil
- Raytracing into eye from infinity or out of the eye from the retina
- Residual wave aberrations determined after correction – object at far point of eye or cornea ablated
Direction in which aberrations are measured

Spherical aberration increases as myopia increases
Effect of direction minimal
Spherical aberration increases as myopia increases – greater rate for the cornea than for the entrance pupil.
Spherical aberration increases as myopia increases – much greater rate for spectacle plane than for entrance pupil.
Effect of myopia correction
- thin ideal lens at cornea

Spherical aberration increases as myopia increases – negligible difference between uncorrected and corrected conditions.
Effect of myopia correction - custom ablation

Correction of spherical aberration better when presurgical aberrations measured relative to cornea than to entrance pupil
Conclusions

- Direction of wave aberration measurement has minimal effects on estimated aberrations
- Reference plane choice (cornea or pupil) is important for highly myopic eyes
- Correcting the eye with ophthalmic correction has little effect on aberrations (provided the plane of correction is unaffected)
- Correcting aberrations by ablation should be more complete if the original aberrations are referenced to the cornea