OFF-AXIS ABERRATIONS OF HUMAN EYES

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INTRODUCTION

Human eyes suffer from a variety of aberrations, both on and off-axis.

Most of the attention on the optics has been concerned with on-axis vision.

Off-axis optics is important for detection thresholds and detection of movement, and for limiting the ability to observe the peripheral fundus.
INTRODUCTION (cont.)

Off-axis optics is dominated by focusing errors - astigmatism and field curvature. Little is known about the magnitude of higher order aberrations eg coma and spherical aberration.

As well as affecting central vision, refractive surgery alters peripheral aberrations and peripheral visual performance, but little attention to this has yet been given.

I have measured aberrations of both normal human eyes and eyes having undergone myopic LASIK across the horizontal meridian
METHOD

Infra-red illumination ring

HeNe Laser (543nm)

Eye

PBS

Fixation Target

Hartmann-Shack micro-lens array

CCD camera
METHOD (cont.)

Cyclopleged eyes

Aberrations determined for 6mm diameter pupils.
RESULTS
Hartmann-Shack images
Asymmetry between T and N fields – latter higher

2nd order peak at 15 T

3rd order aberrations higher in N than T

Little change in 4th order aberrations

5th and 6th order contributions small
Considerable inter-subject differences, particularly for the 2\textsuperscript{nd} order.

This subject has much lower 2\textsuperscript{nd} order order aberration than the previous subject.
3rd order aberrations change by 3x and 5x in temporal and nasal nasal fields, respectively

4th order contribution similar across the visual field

5th and 6th order contributions small relative to 3rd and 4th orders
rms wave aberration (waves)

- 3rd (normal group)
- 4th (normal group)
- 3rd - Lasik subject (-9D)
- 4th - Lasik subject (-9D)

T   visual field angle (degrees)   N
RMS wave aberration (waves)

T    visual field angle (degrees)    N

3rd (normal group)
4th (normal group)
3rd - lasik subject (-4D)
4th - lasik subject (-4D)
SUMMARY

Modified Hartmann-Shack technique used to measure aberrations along the horizontal visual field in normal subjects.

Substantial levels of the 3rd order coma-like aberrations. They increase with off-axis angle and are higher in the nasal than in the temporal visual fields of normal subjects.
SUMMARY (cont.)
Myopic LASIK patients show high aberrations and high refractive errors in the periphery.

Refractive errors are similar to those derived with an autorefractor.

The Hartmann-Shack technique can be successfully modified to analyze peripheral imagery of eyes having undergone refractive surgery.