Reviewer's report

Title: Repeatability of wavefront aberration measurements in small pupil sizes using a clinical Shack-Hartmann aberrometer.

Version: 2 Date: 20 November 2003

Reviewer: Nigel Davies

Reviewer's report:

General comments:

This is a very well written paper, the layout and approach is systematic and logical. The main finding is that the accuracy of measurements varies across the pupil, with increased variance in the periphery. A second finding is that estimation of the wavefront over a small pupil by truncation, as calculated by the COAS aberrometer introduces significant variance, whereas the ‘scaling’ method by Schwiegerling does not. The findings of the study will be of interest to those surgeons planning custom corneal ablation and will raise the awareness of the need for extreme care in measurements of the ocular wavefront.

The authors should consider, however, whether their study addresses the issue of repeatability. As all measurement (of anything) is erroneous, it is appropriate to make a number of measurements of the parameter under investigation and to present the result in a statistical fashion (e.g. the mean and standard deviation). As this study has made a series of 50 data collections in one 6.5 second setting, it could easily be argued that this represents a single measurement on each subject, which was then subjected to analysis. The analysis then can expand on the variability attained during the time period over which the data were collected, but true repeatability must require a second set of data to be collected (i.e. two separate measurements are made) and the results of the two measurements can then be compared using statistical tests.

This to me suggests that the authors should seriously consider changing the title of the study to something like ‘Variability of wavefront aberration measurements in small pupil sizes using a clinical Shack-Hartmann aberrometer’ and adjust the text accordingly to make it clear to the reader that the issue addressed here is the variability obtained when making a measurement of the wavefront using the COAS aberrometer.

Abstract: No changes

Background: This section is written particularly clearly, provides good references to other works in the area. One suggested change in last paragraph – ‘variability’ to replace ‘repeatability’.

Methods: Again, clearly and carefully written.

Subjects: could it be made clear whether any of these subjects had undergone refractive surgery (they should not have, but it would be good to make this explicit).

Procedure: The quoted pupil diameters are to an accuracy of 100 microns. Could the authors include a short sentence on how pupil size was measured to this level by the machine.

Data analysis: Please expand on how the coefficients were corrected for chromatic aberration. This point is very important, after all, the key for corneal surgery is that the wavefront is corrected for visible not invisible wavelengths!

Results:

Figure 1: the difference maps area good illustration of the results obtained by the ‘direct’ and
‘scaling’ methods.
Figures 2 and 3: These are difficult to interpret. The symbol size is far too large and should be reduced. Also, the presentation of the data should be made as the mean of the 50 data sets along with a metric of the variability (i.e. error bars of +/- one standard deviation). These graphs must be redrawn with smaller mean data points and the error bars added. This would improve them considerably.

The results section does not present solely the results of the experiment, but drifts rather into a presentation of results and a short discussion of them (e.g. paragraph 3 in the section ‘comparison of the two scaling methods’). I would usually prefer to keep the results devoid of any interpretive statements, however, in this case leaving the text unchanged is helpful for the reader to understand the implications of the results, particularly as several different analyses have been performed.

Discussion: The discussion is clearly written and covers all the necessary points arising from the study. It also serves to raise awareness in the clinical community of the difficulty of making these measurements and the caution that must be taken in their application to definitive surgical procedures. I do, however, suggest that in the first sentence ‘repeatability’ is changed to ‘variability’ in the light of my initial general comment.

Review summary:

Compulsory revisions:
1. Title and wording change to remove ‘repeatability’ and replace with ‘Variability’ and to make this point clear in the text (major)
2. Explicit statement of no previous refractive surgery in the subjects (minor)
3. Details of the correction for chromatic aberration (major)

Discretionary revision:
1. Pupil size measurement

What next?: Accept after minor compulsory revisions

Level of interest: An article whose findings are important to those with closely related research interests

Quality of written English: Acceptable

Statistical review: No