Author Response: “Metamorphopsia” Assessment

Ugarté and Williamson address the need to distinguish between dysmetropsia, which affects the entire visual field, and micropsia and macropsia, which affect only a part of the visual field, the latter condition being confined largely to the center of the visual field. They refer to our recent study of patients with macular holes, in which the objective was to assess centrosymmetric metamorphopsia before and after surgical treatment of macular holes in patients with a healthy fellow eye. We do not propose that our test has any relevance outside the confines of this situation, in which it is known beforehand that the patient has an idiopathic macular hole. We have shown that metamorphopsia is centrosymmetric in eyes with a macular hole, and it is therefore reasonable and of considerable practical utility to reduce the test to one of centrosymmetric image distortion.

Ugarté and Williamson address the need to clarify the dimensions of the test stimuli. Test stimuli ranged from being identical with the reference stimulus to an extra width of up to 1.5° of visual angle. “Width” thus refers to the diameter of the retinal image produced by the test stimulus which was increased in size by increments of 0.5°. Thus, for each of the five reference stimuli, the patient had four test stimuli of different sizes to choose from, the objective being to choose the one that best matched the reference stimulus. This gave a total of 20 combinations.

Ugarté and Williamson correctly note that a stimulus diameter of 2.34° would correspond to 673.92 µm on the retina. However, they make an incorrect conclusion about the stimulus that is being projected within the hole, by comparing the average disparity at 1° with the macular hole diameter range. The quoted 0.34° of disparity at 1° eccentricity is a mean value for 42 patients with a mean hole diameter of 438 µm (range, 199–735 µm). They wisely suggest titrating the test stimulus to the hole size by projecting targets of different size before performing the test. We fully agree. We must point out, however, that this methodology is actually already an integral part of the test, as described in our previous article. Specifically, there were 48 instances in which the reference stimulus, ranging in angular subtense from 1.0° to 5.0°, could not be matched by a test stimulus, presumably because the reference stimulus fell entirely within the central scotoma in the eye with the macular hole and therefore could not be seen. Ugarté and Williamson correctly point out that the vertical and horizontal components of size difference have not been quantified separately. However, we do not make any conclusions about the vertical and horizontal component of size perception. We do find evidence to support the assumption that the displacement of photoreceptors around a macular hole is more or less uniformly radial, following a meridional direction away from the center of the fovea, and is of roughly equal magnitude in all directions.

Because the stimuli we used were semicircular and had to be matched along their opposing vertical surfaces such that, together, they appeared to form a full circular target, our method may have been biased toward measuring photoreceptor displacement along the vertical meridian. Our finding that reports of micropsia were actively expressed by only a subset of patients expressing distorted vision could be explained by the fact that micropsia is harder to recognize by the patient than simply image distortion.

Kristian Kroyer
Ulrik Christensen
Morten la Cour
Michael Larsen

1Department of Ophthalmology, Glostrup Hospital, University of Copenhagen, Denmark; the 2National Eye Clinic, Kennedy Center, Copenhagen, Denmark.

E-mail: kroyers@yahoo.com

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5. The Mann-Whitney rank sum test, which was used to compare pre- and postoperative metamorphopsia is meant for comparing the means of two independent samples. As the pre- and the postoperative groups were dependent, the Wilcoxon signed rank test seems more appropriate. The effect of eccentricity on metamorphopsia was determined by the analysis of variance test, which is for parametric data. As the distribution is non-parametric, the Kruskal-Wallis test seems more appropriate.
6. The results report that eight patients underwent reoperation to close the hole and that four patients did not show any change in metamorphopsia after surgery. Were these four patients among those who underwent reoperation?
It would be useful to the readers to have the authors clarify these points.

Vivek Dave
Raja Narayanan

L. V. Prasad Eye Institute, Hyderabad, India.
E-mail: vivekoperates@yahoo.co.in

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Citation: Invest Ophthalmol Vis Sci. 2010;51:6895–6896. doi:10.1167/iovs.10-5587

Author Response: Metamorphopsia Assessment before and after Vitrectomy for Macular Hole

Dave and Narayanan address the need to clarify a few points in our article, “Metamorphopsia Assessment before and after Vitrectomy for Macular Hole,” in which we described the quantification of metamorphopsia in a subset of patients included in the Copenhagen Macular Hole Study, a randomized clinical trial (RCT) comparing different methods of surgical treatment for macular hole.

Dave and Narayanan correctly note that the number of patients enrolled in the RCT was 78, whereas only 55 patients were enrolled in the study describing our novel method of metamorphopsia assessment. In the study of metamorphopsia, 23 patients were excluded because they did not fulfill the inclusion criteria or were unable to complete the test for one of the following reasons: bilateral macular hole or lamellar hole at baseline (n = 12), anisometropia greater than 3 D (n = 3), amblyopia in the fellow eye (n = 1), or inability to complete the test, most commonly because of excessive phoria or exclusive eye dominance (n = 7).

In the group of patient who did not show any change in metamorphopsia after hole closure (n = 4), two had undergone reoperation to close the hole. Another six patients experienced metamorphopsia reduction despite having had two operations.

Dave and Narayanan address the need to validate the test-retest variability of our method. We determined variability by examining patients twice at baseline with a short interval between each test. Calculating the Pearson’s correlation coefficient between the two sets of responses showed a correlation coefficient of 0.71 (P < 0.001).

Dave and Narayanan suggest that the Wilcoxon signed-rank test would be more appropriate for comparing pre- and postoperative metamorphopsia, because the groups under comparison are dependent and cannot be assumed to be normally distributed. We believe that this argument is valid, and consequently we have made the same comparison using the Wilcoxon signed rank test which also shows a significant difference between pre- and postoperative metamorphopsia for all the tested eccentricities (P < 0.001). Means and standard deviations of the metamorphopsia measure before and after surgery are presented graphically in Figure 1, “Metamorphopsia before and after surgery.”

We used the one-way ANOVA test to compare metamorphopsia before and after surgery. Our data were nonparametric but expressed homogeneity of variance. However, we believe that Dave and Narayanan are correct when arguing that the Kruskal-Wallis one-way analysis of variance may be more appropriate for nonparametric data. Analyzing the effect of eccentricity on metamorphopsia using the Kruskal-Wallis test, however, does not alter our results or our conclusions.

In the Results section, a reference is made to Figure 2 regarding the effect of eccentricity on the degree of metamorphopsia reduction after surgery. The reference should have been made to Figure 3.

Kristian Kroyer
Ulrik Christensen
Morten la Cour
Michael Larsen

1Department of Ophthalmology, Glostrup Hospital, University of Copenhagen, Denmark; and the 2National Eye Clinic, Kennedy Center, Copenhagen, Denmark.
E-mail: kroyers@yahoo.com

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Citation: Invest Ophthalmol Vis Sci. 2010;51:6896. doi:10.1167/iovs.10-6082

Model-Fitting Adequacy and Clinical Rationality in Multivariate Linear Regression Analysis

I read with great interest the article by Wong et al.1 reporting the distribution and determinants of ocular biometric parameters in a Singapore Malaysian population. This population-based, cross-sectional study was well designed, and the use of partial coherence interferometry ensured the superior accuracy of the ocular biometric measurements. Two-step multivariate linear regression was used for evaluation of the relationship between ocular parameters and other independent variables. An age- and sex-adjusted model was used for each variable first, and those that were significant during the first step were recruited for second-step multivariate regression with backward selection. However, I was puzzled about Table 5, which showed the results of multivariate linear regression models. For example, the standardized β statistics for “Height, cm” are 0.162, 0.075, and 0.250 for AL, ACD, and CC, respectively. These statistics mean that when body height increases 10 cm, AL and ACD will increase 1.62 and 0.75 mm, respectively, which are quite large numbers for AL, averaging 23.55 mm, and ACD, averaging 3.1 mm. Also, for the model of ACD, the standardized β for “Age, y” is ~0.358, which means an average of 0.358 mm decrease of ACD per year, meaning that one’s ACD would decrease to 0 when he or she is 9 years older!

It is possible that the unit of height in regression models was the number of quartiles, not centimeters, or that there was a typographical error in Table 5. If not, perhaps the adequacy of the regression models should be examined. Plots of residuals against questionable variables can be used to check for model-fitting adequacy. For the model of ACD, at least two parameter estimates are extreme (age and height), in which overparameterization or collinearity among independent variables may result. The former should not happen, because there are only five parameters to be estimated for 2788 samples. As for the