Vision Science II – Monocular Sensory Aspects of Vision Name ___________________

Lab 1 – Clinical aberrometry

INTRODUCTION

An aberrometer is like a super autorefractor that measures not only the sphere and cylinder, but also the higher-order aberrations. The purpose of this lab is to familiarize you with the *Complete Ophthalmic Analysis System* (COAS), a clinical Shack-Hartmann-type aberrometer. Each student should record aberrations for his/her right eye and take a measurement of someone else's eye.

Prepare for the measurement.

- Enter new patient data under the Database menu.
- Set analysis pupil size to 5.0 mm.
- Position the patient and adjust the table and chin rest height so the patient is comfortable.
- Click “Start” and, with the room lights on, center the reference dots and box in the pupil.
- If necessary, turn off room light to increase pupil size.

Take the measurement.

- Fine-tune the focus and alignment.
- Ask the patient to blink a few times, and maintain steady fixation on the red dot.
- Click the “Refract” button. The machine will estimate the refractive error.
- After the machine has adjusted its focus, reclick “Start” and ask the patient to blink again and re-fixate. About 2 seconds after the blink …
- Click the “Acquire” button. This makes the actual measurement.
- If the measurement looks good, save it to the database.

Note the following on the display.

- Numerical data: sph, cyl, axis, pupil dia, 3rd order coefficients and total HO RMS.

Q. What is a Zernike mode? What is a Zernike coefficient?

- Standard ophthalmic Zernike coefficients are labeled OSA(3,-3), OSA(3,1), etc. "OSA" refers to the standard Optical Society of America designation used in optometry and ophthalmology. The first number is the Zernike order; the second number identifies the aberration within that order.
- RMS = root mean square. It combines and quantifies the magnitude of the Zernike coefficients in a single number.

Q. What happens to the RMS and Zernike coefficient values when you change pupil size?

- Wavefront maps show the surface shape of a wavefront of light that has been distorted by the eye's refractive errors.
- Top map = total refractive error (lower & higher-order aberrations). Bottom map = higher-order aberrations only.
- Raw image (Shack-Hartmann dot pattern) is what the computer analyzes to compute the map and Zernikes.
- Simulated retinal image of a Snellen letter with and without correction.
- See the three-dimensional animation of the wavefront by choosing, from the “Analyze” menu, “3-D Plot.” Adjust the “pitch” of the plot and select “Rotate.”

Record the following COAS data for your eye.

	Sph	**Cyl**	**Ax**								
Clinical Rx				Pupil	OSA(3,-3)	OSA(3,-1)	OSA(3,1)	OSA(3,3)	OSA(4,0)	HO RMS
COAS Rx										

Assignment

1. COAS refraction

Compare your COAS and clinical refraction data. Was the COAS accurate? As a lab group (6-7 students) discuss the following questions and be prepared to summarize your discussion in class tomorrow.

- How would you mathematically quantify accuracy of the COAS?
- How good was the COAS (in terms of accuracy) across your group?

2. Higher-order aberrations

Compare Zernike coefficient values (all 3rd order modes and OSA(4,0)) and total HO RMS with other members of your group. Discuss the following questions and be prepared to summarize your discussion in class tomorrow.

- How good were the values for the eye with the best optical quality?
- How can you compare optical quality for different eyes, or the same eye under different conditions? (For example, before and after refractive surgery)
- How can you evaluate how good or bad the values are?