IT'S ALL ABOUT THE BUMP

By

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And

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ABSTRACT

Background: Handheld digital devices such as cell phones and tablets have changed the visual demands of students and working adults. Extended near work can cause visual symptoms such as discomfort or tired eyes. Lenses have been introduced to the market that help relieve visual fatigue for pre-presbyopes. *Methods:* In this study, examiners used the Rotlex Class Plus analyzer to evaluate four styles of fatigue reducing spectacle lenses, each with a different "bump" in add power. Three distance powers of each style of lens were masked, and analyzed by each student with the Rotlex analyzer and a lensometer. *Results:* Each style and power of lens was analyzed for varying characteristics such as the area of the full add power, the characteristics of the transition zone, and the distance between the optical centers. *Conclusions:* This information will provide eye care practitioners with more data on fatigue reducing lenses, which will help determine which lens is most appropriate for each patient.

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CHAPTER 1

INTRODUCTION TO FATIGUE REDUCING LENSES

Handheld digital devices such as cell phones and tablets have changed the visual demands of students and working adults. Extended near work can cause visual symptoms such as discomfort or tired eyes, now termed Computer Vision Syndrome. Patients most commonly complain of symptoms of eye fatigue, irritation, and blurred vision.[1] Lenses have been introduced to the market that help relieve visual fatigue for pre-presbyopes. This study analyzes the designs of various "anti-fatigue" lenses that are intended for the visual demands of the pre-presbyopic patient.

Companies are now advertising lenses specifically made to help decrease visual fatigue or asthenopia caused by high digital media usage, while also trying to decrease the adaptation time and distortion that comes with progressive lenses. Technology is becoming increasingly present in classrooms, as textbooks are being converted to digital media and more assignments are completed online. As near demands are increasing from an earlier age, practitioners are seeing an increase in asthenopia and computer vision syndrome.

Near spectacle power additions can be prescribed to pre-presbyopic patients in order to reduce these symptoms, but the amount of add to prescribe can be a challenging decision. Fatigue reducing lenses were designed for these patients with a low add power, to relax the accommodative system while reducing the amount of adaptation time.

CHAPTER 2

METHODS

The Rotlex Class Plus analyzer was used to evaluate four styles of fatigue reducing spectacle lenses, each with a different "bump" in add power. The four lens designs used in this study were Essilor's Eyezen+, Hoya Sync 8, Hoya Sync 5, and Shamir Relax. Three distance powers of each style of lens were masked and analyzed by each student with the Rotlex analyzer and a manual lensometer. The three distance powers of each lens were plano, +2.50D, and -2.50D. A masked study was conducted to reduced examiner bias. Each examiner used the same equipment on the same day.

Cut and uncut lenses were used in this study. All measurements were taken first with uncut lenses and then repeated after the lenses were cut. Distance and near lens power was first measured with a manual Marco lensometer model LM-101. The distance optical center was then marked. Using the distance optical center marked using the lensometer, the base curve and center thickness were measured with a lens clock and thickness calipers, respectively. These parameters were then put into the Rotlex Class Plus analyzer, along with the lens itself. The analyzer mapped each lens using the 0.125D change in power map. The following parameters were then measured by each examiner using the power map: width and height of add zone, largest amount of add power (to

0.125D), area of largest add power (to 0.125D), distance from optical center to the top of the add zone (to 0.125D), number of different 0.125D power zones in the add, distance from the top of the add zone to the top of the largest add, and distance power measured by the Rotlex.

After all parameters were measured and the lens was mapped, all lenses were then cut to the same frame using each lens manufacturers' fitting guide. The frame used was Fundamentals F021. The following parameters were then measured in the cut lenses: width of add zone, height of add zone, distance from optical center to the top of the add, largest add power measured, area of largest add power, distance power measured by Rotlex, number of different 0.125D power zones in the cut lens.

CHAPTER 3

RESULTS

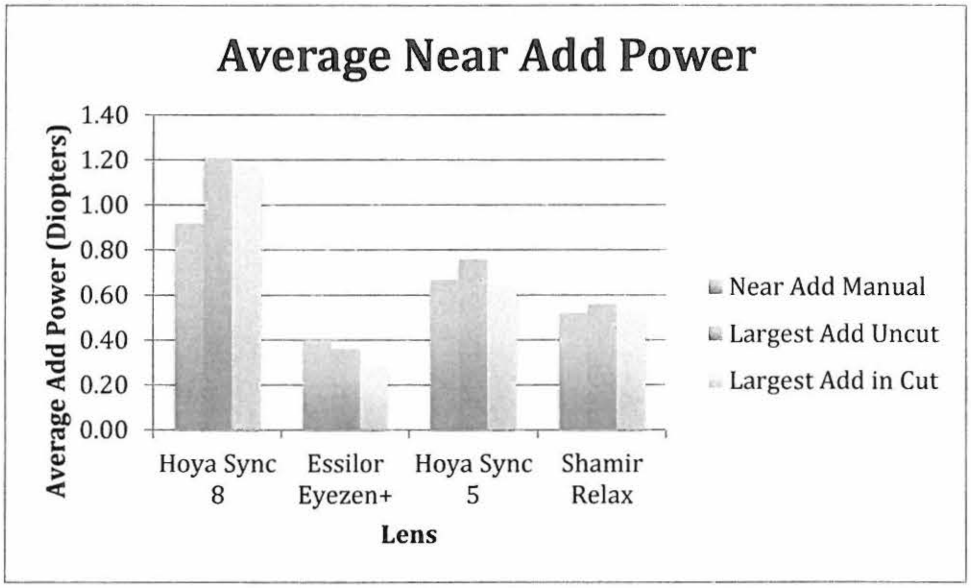
Parameters measured by each examiner were recorded in a spreadsheet and averaged. The averaged findings were then used to analyze the data. A table of the averaged data from each lens can be found in Appendix A. Rotlex maps showing the changes in lens power throughout each of the plano cut lenses can be found in Appendix B.

Distance power, lens center thickness, and front base curves were measured manually in this experiment in order to identify any outliers. All distance powers measured with a manual lensometer were within ANSI standards of tolerance except for the Eyezen+ +2.50D and the Sync 5 +2.50D, which were off by 0.19D in each lens. The lens center thickness and front base curves were all deemed normal for the lens power in CR-39 material.

The largest measured add power of an uncut lens in the manual lensometer was +1.16D found in the Sync 8 -2.50D. The lowest measured add power was +0.25D found in the Eyezen+ +2.50D. The largest measured add power with the Rotlex analyzer was +1.28D found in the Sync 8 Plano lens, while the lowest measured add power was +0.33 found in Eyezen+ +2.50D.

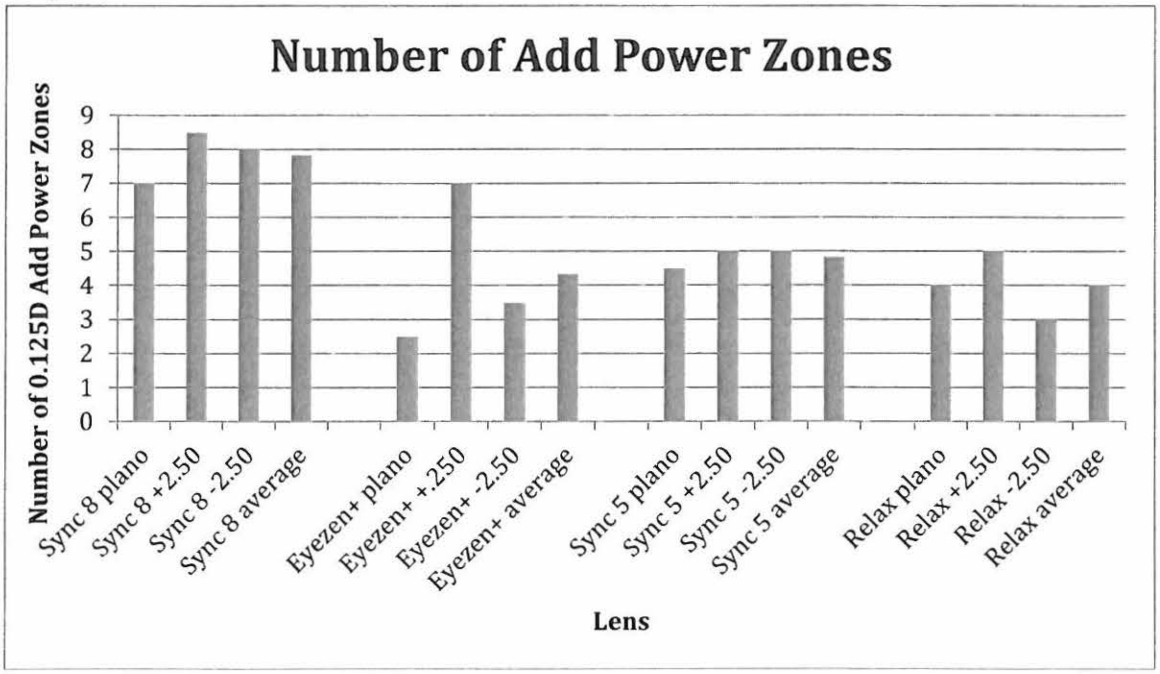
The average addition power for each uncut lens in the manual lensometer is as follows: +0.92D, SD 0.18 for Hoya Sync 8; +0.40D, SD 0.11 for Essilor Eyezen+; +0.67D, SD 0.03 for Hoya Sync 5; and +0.52D, SD 0.06 for Shamir Relax. Measurements averaged from the Rotlex were as follows: +1.21D, SD 0.06 for Hoya Sync 8; +0.36D, SD 0.02 for Essilor Eyezen+; +0.76D, SD 0.12 for Hoya Sync 5; and +0.56D, SD 0.09 for Shamir Relax. See Graph 1.

Graph 1



The number of different 0.125D add power zones were mapped by the Rotlex analyzer in the cut lenses. The lens with the largest number of add power zones was the Sync 8 +2.50 with 8.5 different power zones. The lens with the lowest number of add power zones was Eyezen+ Plano with 2.5 different power zones. The average number of power zones for each brand of lens are as follows: 7.8, SD 0.6 for Hoya Sync 8; 4.3, SD 1.9 for Essilor Eyezen+; 4.8, SD 0.2 for Hoya Sync 5; and 4.0, SD 0.8 for Shamir Relax. See Graph 2.

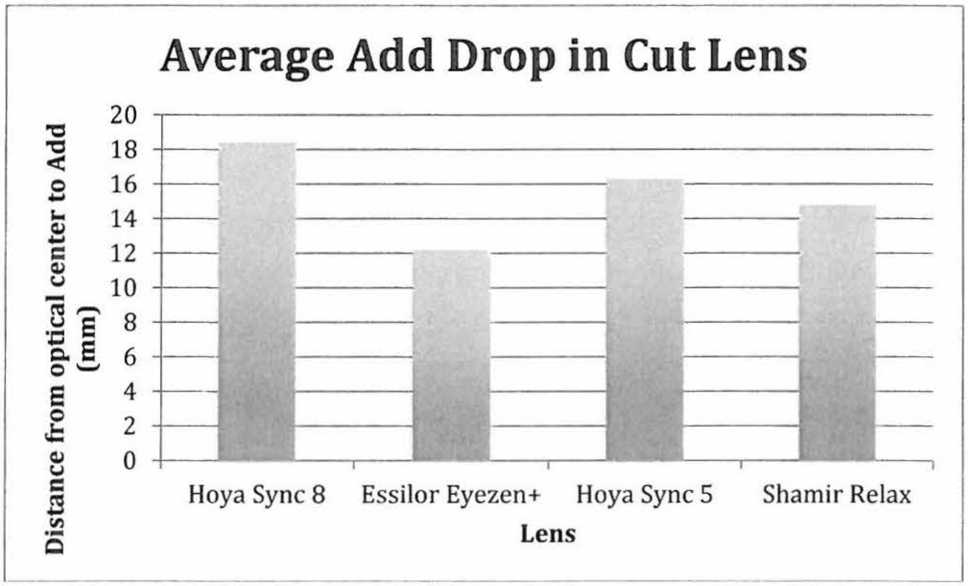
Graph 2



The area of the largest add power in each cut lens was measured using the Rotlex analyzer. The Eyezen+ Plano lens had the largest area with 164.01 mm^2, while Sync 8 +2.50D had the smallest area with 12.92 mm^2. The average area of the largest add power for each brand of lens is as follows: Hoya Sync 8 14.70 mm^2, SD 1.58; Essilor Eyezen+ 77.21 mm^2, SD 62.16; Hoya Sync 5 22.42 mm^2, SD 2.20; and Shamir Relax 35.11 mm^2, SD 18.11.

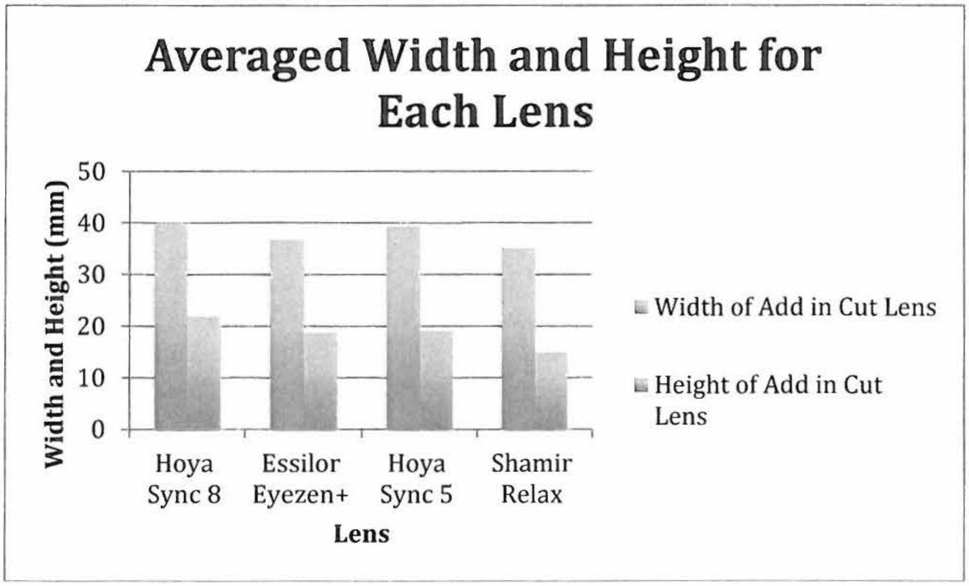
The distance between the distance optical center and the top of the largest add power was measured with the Rotlex in the cut lenses. Sync 8 +2.50D had the largest distance between these areas with 20 mm, and Eyezen+ Plano lens had the smallest distance between these areas with 6.70 mm. The average distance between these areas for each of the types of lenses is as follows: 18.43mm, SD 1.27 for Hoya Sync 8; 12.21 mm, SD 3.97 for Essilor Eyezen+; 16.31 mm, SD 0.70 for Hoya Sync 5; and 14.79mm, SD 1.02 for Shamir Relax. See graph 3.

Graph 3



The width and height of the full add zone was measured for each lens in each power and then averaged for analysis. The lens with the largest average width was Hoya Sync 8 at 40.02mm and the lens with the smallest average width was Shamir Relax with 35.2mm. The lens with the largest average height was Hoya Sync 8 with 21.98mm and the lens with smallest average height was Shamir Relax with 14.92mm. See Graph 4 for the other average widths and heights.

Graph 4


Averaged Width and Height for Each Lens
Width and Height (mm)
50
40
30
20
10
0
Hoya Sync 8
Essilor Eyezen+
Hoya Sync 5
Shamir Relax
Lens
Width of Add in Cut Lens
Height of Add in Cut Lens

CHAPTER 4

DISCUSSION

Digital devices are used two or more hours per day by 90% of Americans.[2] This increase in near tasks can cause asthenopia. Using the Rotlex Class Plus Analyzer to map these lenses gives insight into how similar the parameters are to what is advertised and how effective these lenses are for the wearer.

The first lens picked for this trial was Essilor's Eyezen+, previously labeled Anti-Fatigue. The Eyezen+ lens is advertized to reduce digital eye strain and exposure to harmful blue light. The lens comes in three different add powers, which are designed for different age groups; Eyezen+ A has an add of 0.40 D for ages 18-34, Eyezen+ B has an add of 0.60 D for ages 35-44, and Eyezen+ C has an add of 0.85 D for ages 45-50. The Eyezen+ lens also comes with a built-in smart blue filter that reduces the amount of blue light that enters the eye.[3] The lens used in this study was the Eyezen+ B lens which is advertised with a +0.60 D add power. A study conducted by Eurosyn Consumer Science, a French market research institute, concluded that the Eyezen+ lenses reduced the symptoms of visual and postural fatigue, reduced glare, and improved contrast sensitivity. The study found that 91% of wearers had comfortable vision while working at the computer and 91% were satisfied with the Eyezen+ lens.[4]

For the Essilor Eyezen+ lens, we measured the averaged add power in the cut lens at +0.29 D, while the advertised add power is +0.60 D. This is not within ANSI standards for ophthalmic lenses, which has a tolerance of +/-0.12D. This lens had the lowest measured add power along with a small number of different add power zones. Smaller number of varying add powers reduces distortions and adaptation time. This lens had the largest full add power area allowing easier use of the full amount of add, even though it is a smaller size. See Appendix B Essilor Eyezen+ lens maps. The full add power is easy to find in the lens because it has the smallest distance from the distance OC to the largest amount of add. The lens wearer's eye does not need to drop down in the lens vary far in order to reach the add, however this could cause some distortion while viewing distance objects. This lens would likely be useful for young patients due to the small power of the add and the limited number of different power zones.

The next lenses chosen for this study were the Hoya Sync lenses. The Sync lens is advertised as a single vision lens with an increase in add power at the bottom of the lens to reduce accommodation used during use of digital devices. The add is designed to spread across the bottom part of the lens from edge to edge. The Sync lens is advertised to relax vision in all directions and at all distances along with reduced eye fatigue and strain. The Sync lenses use radial aspherization, vertical aspherization, and combined support to relax binocular vision in all directions, allowing consistently clear images with depth perception, and relax focusing and refocusing. Radial and vertical asperization provide separate but balanced right and left lenses to produce overlapped retinal images. The Hoya Sync lenses are available in two designs; Sync 5 for young adults such as students which has a gradual increase in add up to +0.53 D and Sync 8 for early presbyopes which has an add power up to +0.88 D.[5] Both lenses were used in this study. A small initial study conducted by Hoya found that 84% of Sync lens users were satisfied with their lenses. Five percent of the subjects found the Sync lenses uncomfortable or were unable to adapt to distortions.[6]

For the Hoya Sync 8 lens, we measured the averaged add power in the cut lens at +1.16 D, while the advertised add power is +0.88 D. This is not within ANSI standards for ophthalmic lenses, which has a tolerance of +/-0.12D. This lens had the highest add power, and thus more zones of increasing power. This could be helpful for lens wearers with varying working distances, but can increase the amount of distortion and adaptation time for the lens. The area of the largest add power was the smallest in this lens, meaning that even though the lens has the highest add, lens wearers are less likely to be able to use the zone of full add power. The distance between the distance OC and the full add power was also the largest in this lens, making it more difficult for the eye to reach the full add power. See Appendix B Hoya Sync 8 lens maps. A lens wearer's eyes will have to move lower in the lens in order to use the full add power, as compared to the other lenses. This lens has the overall largest area with add power, making it easier for patients to use some portion of the add, however distance vision could be slightly interrupted since the add starts higher in the lens.

For the Hoya Sync 5 lens, we measured the averaged add power in the cut lens at +0.64 D, while the advertised add power is +0.53 D. This is within ANSI standards for ophthalmic lenses. All of the measurements for Hoya Sync 5 were consistent with the amount of add power. Since the add was neither the highest nor lowest, none of the other data parameters stood out. Based on our data, this lens should be easy to adapt to and use.

None of the data collected had large discrepancies between the different distance power lenses. Overall, this lens had consistent numbers which shows a reliable lens design.

The final lens selected for this study was the Shamir Relax lens. The Relax lens is advertised as a fatigue reducing lens for pre-presbyopic patients who spend most of their day looking at near targets or working on a computer. The lens design has a small semicircular increase in power of 0.65 D at the bottom of the lens. The advertised benefits include fatigue reduction, no distortion, and up to 30% reduction in accommodation. The Relax lenses are a Freeform digital single vision lens with a aspheric design.[7]

For the Shamir Relax lens, we measured the averaged add power in the cut lens at +0.53 D, while the advertised add power is +0.65D. This is within ANSI standards for ophthalmic lenses, which has a tolerance of +/-0.12D. This lens had the smallest number of different add power zones, meaning there should be minimal distortion in this lens. See Appendix B Shamir Relax lens maps. The height and width of the add was the smallest in this lens. The height of this add is least likely to interfere with distance viewing, but the small width may make reading more difficult. While reading, the wearer would need to move their whole head instead of just their eyes in order to stay within the add zone.

Examiner error played a role in data discrepancies in this study. Numbers were averaged from the two examiners to try to minimize this. Discrepancies found between the two examiners were more prevalent with parameters measured using the Rotlex Analyzer. When analyzing the data, it was found that most lenses fell outside ANSI standards for the distance power with the Rotlex, but not with manual lensometer. It is recommended that future studies measuring similar lenses should investigate how to better standardize setup and measurements when using the Rotlex Class Plus Analyzer.

CHAPTER 5

CONCLUSION

Fatigue reducing lenses are marketed to pre-presbyopes and those who do near work for extended periods of time. Prescribing this type of lens for patients with computer vision syndrome or visual fatigue can be a successful treatment option. Each of these lenses offer different parameters, allowing the practitioner to decide which type of lens is best suited for their patient.

This data will be helpful for future studies involving human subjects, to determine the cause behind patients who can or cannot adapt to each lens or other reasons the lenses are successful for some subjects and not for others.

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APPENDIX A

RESEARCH DATA

RESEARCH DATA

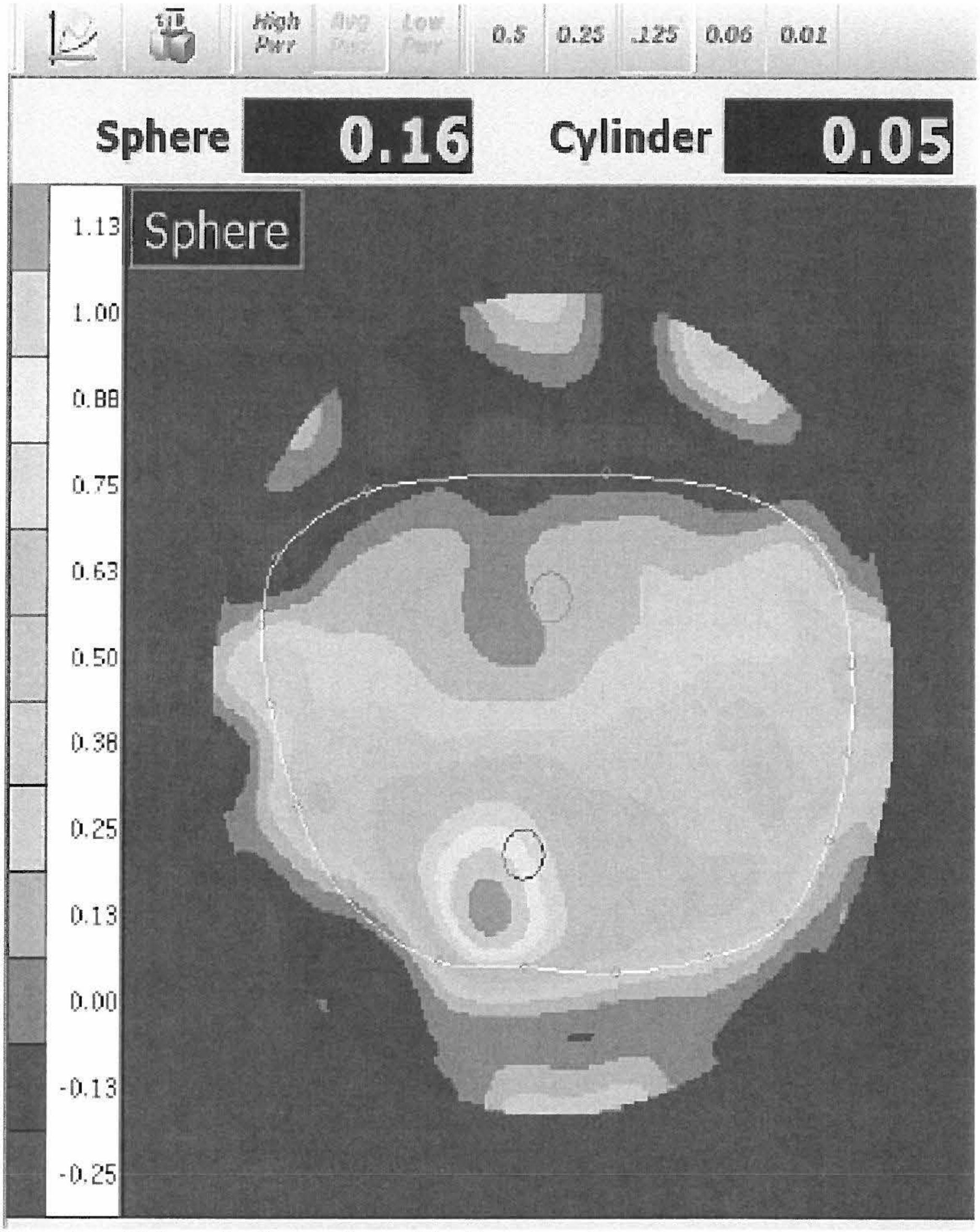
Parameter:	Sync 8 plano	Sync 8 +2.50	Sync 8 -2.50	Eyezen+ Plano	Eyezen+ +2.50	Eyezen+ -2.50	Sync 5 Plano	Sync 5 +2.50	Sync 5 -2.50	Relax Plano	Relax +2.50	Relax -2.50
Distance Power measured in manual lensometer (Diopters)	0.0625	2.5625	-2.375	0.0625	2.6875	-2.5	pl	2.6875	-2.3725	pl	2.5	-2.5
Near Add Power measured in manual lensometer (Diopters)	0.9375	0.6875	1.125	0.4375	0.25	0.5	0.625	0.6875	0.685	0.5625	0.5625	0.4375
Front Lens curvature with lens clock (Diopters)	5	5.5	4.125	3.875	5.75	3	5.375	5.125	4.25	4.125	5.375	3.25
Center Thickness with calipers (mm)	2.1	4	2.05	2.45	4.6	2.1	1.95	3.75	1.9	2.05	4.35	2.25

Uncut Lens Rotlex Measurements	Sync 8 plano	Sync 8 +2.50	Sync 8 -2.50	Eyezen+ plano	Eyezen+ +2.50	Eyezen+ -2.50	Sync 5 plano	Sync 5 +2.50	Sync 5 - 2.50	Relax plano	Relax +2.50	Relax -2.50
Width of add - horizontal/x-axis (mm)	35.855	43.35	49.815	46.18	48.95	49.11	47.74	40.805	43.895	39.17	43.26	26.655
Height of add - vertical/y axis (mm)	28.64	28.96	31.805	29.925	30.84	29.935	28.01	29.05	23.715	29.175	29.31	34.855
Largest amount of Add power measured by Rotlex (Diopters)	1.28	1.2	1.14	0.385	0.33	0.375	0.79	0.89	0.595	0.55	0.665	0.45
Area of fullest add power (to 0.125D in mm2)	31.399	10.2425	39.295	61.099	53.835	71.125	72.245	2.87	54.74	39.925	91.495	78.185
Distance from OC to top of largest add power (to 0.125D in mm)	31.43	26.37	21.615	14.86	14.355	9.84	23.77	29.095	12.13	19.16	15.11	19.755
Distance power in Rotlex Uncut Lens	0.105	2.755	-2.33	0.105	2.735	-2.34	0.085	2.71	-2.365	-0.045	2.565	-2.45
Number of different 0.125D power zones in the add	8.5	9	8	3.5	3.5	3.5	5	9	6.5	4.5	5.5	5
Distance from top of add zone to top of the largest add (to 0.125D in mm)	24.275	19.245	16.6	8.675	7.05	14.71	16.91	27.53	10.08	8.41	11.97	12.645

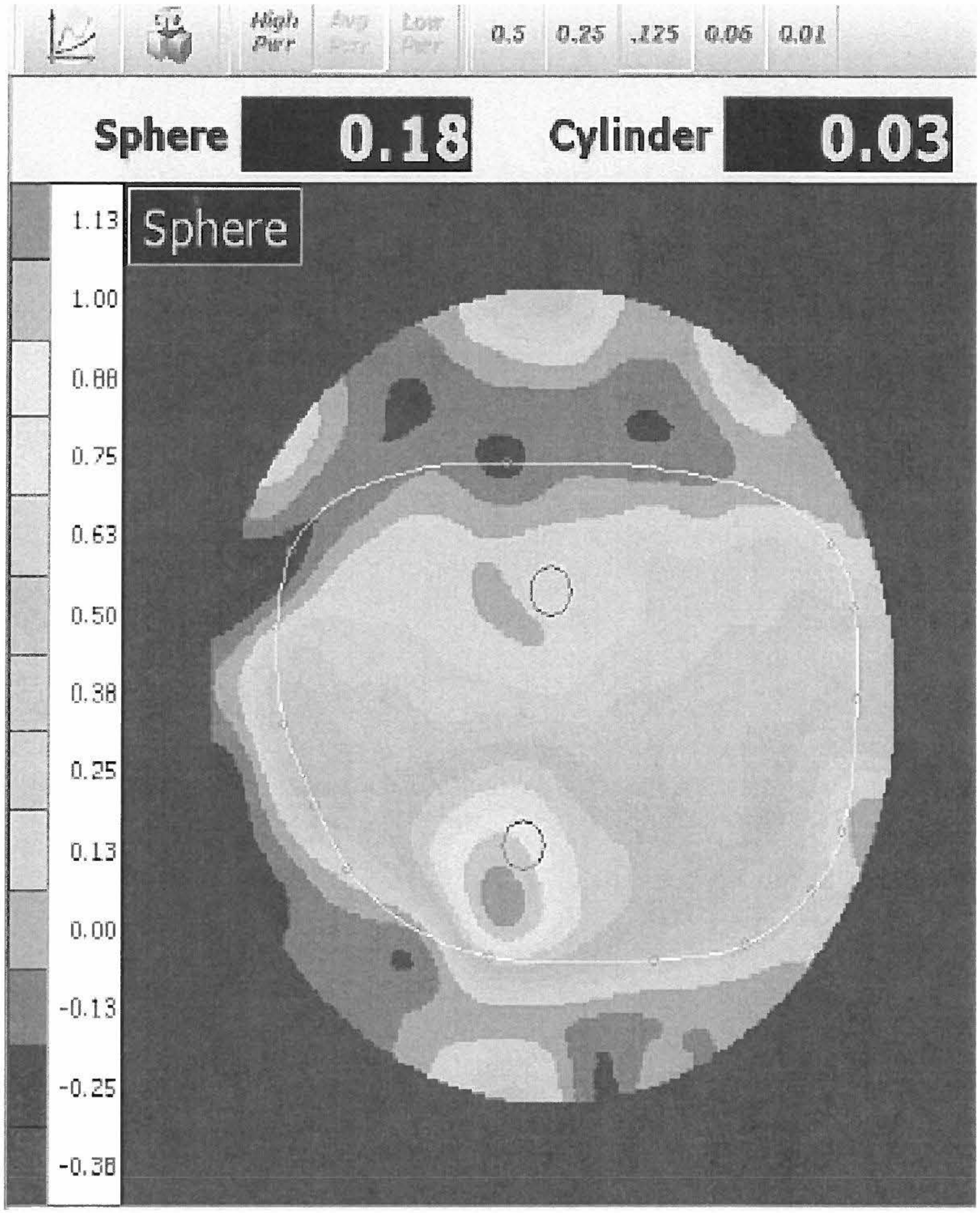
Cut Lens Rotlex Measurements	Sync 8 plano	Sync 8 +2.50	Sync 8 -2.50	Eyezen+ plano	Eyezen+ +2.50	Eyezen+ -2.50	Sync 5 plano	Sync 5 +2.50	Sync 5 -2.50	Relax plano	Relax +2.50	Relax -2.50
Width of add in cut lens (mm)	40.55	39	40.5	43.2	26.785	40.45	39.15	38.9	39.25	35.15	41.9	28.55
Height of add in cut lens (mm)	21.15	18.55	18	26.25	15.77	14.95	19.35	20.1	18.1	15.55	16.95	12.25
Distance from OC to top of the largest add power (to 0.125D in mm)	18.415	20	16.885	6.695	15.915	14.005	16.855	16.75	15.315	15.21	15.765	13.38
Difference in area between uncut and cut lens (mm2)	14.634	-2.6775	24.895	-102.911	32.065	25.275	47.01	-16.995	32.59	23.405	62.345	18.524
Largest Add power measured by Rotlex in Cut lens (Diopters)	1.05	1.404	1.065	0.25	0.35	0.275	0.62	0.65	0.66	0.52	0.65	0.41
Area of largest add power (to 0.125D in mm2)	16.765	12.92	14.4	164.01	21.77	45.85	25.235	19.865	22.15	16.52	29.15	59.66
r for largest add power (mm)	2.31	1.98	2.14	7.22	2.385	3.82	2.77	2.455	2.65	2.29	3.045	4.355
Distance power from Rotlex in cut lens (Diopters)	0.12	2.725	-2.31	0.185	2.675	-2.265	0.115	2.695	-2.355	0.005	2.52	-2.425
Number of different 0.125D powers in cut lens	7	8.5	8	2.5	7	3.5	4.5	5	5	4	5	3

APPENDIX B

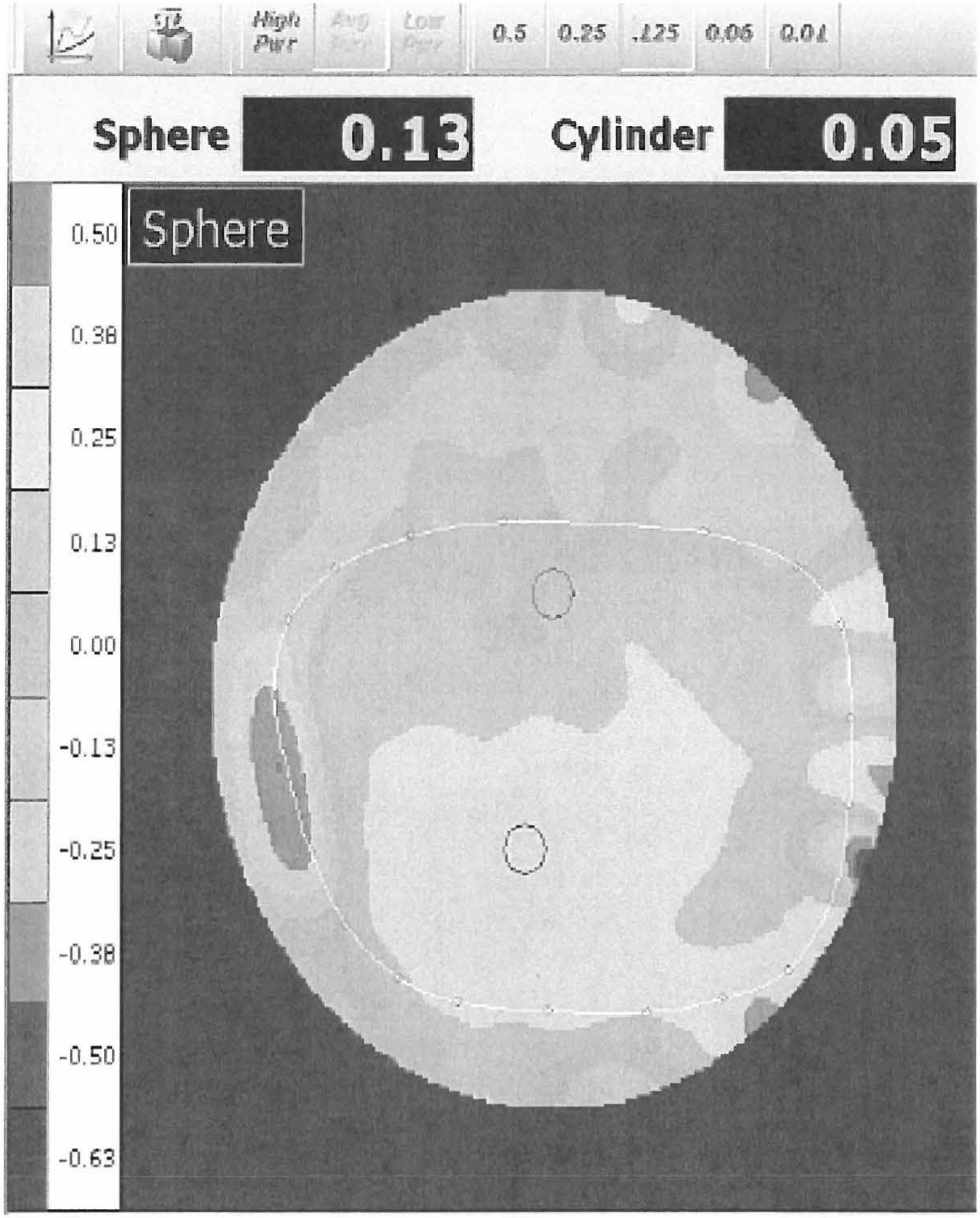
ROTLEX POWER MAPS



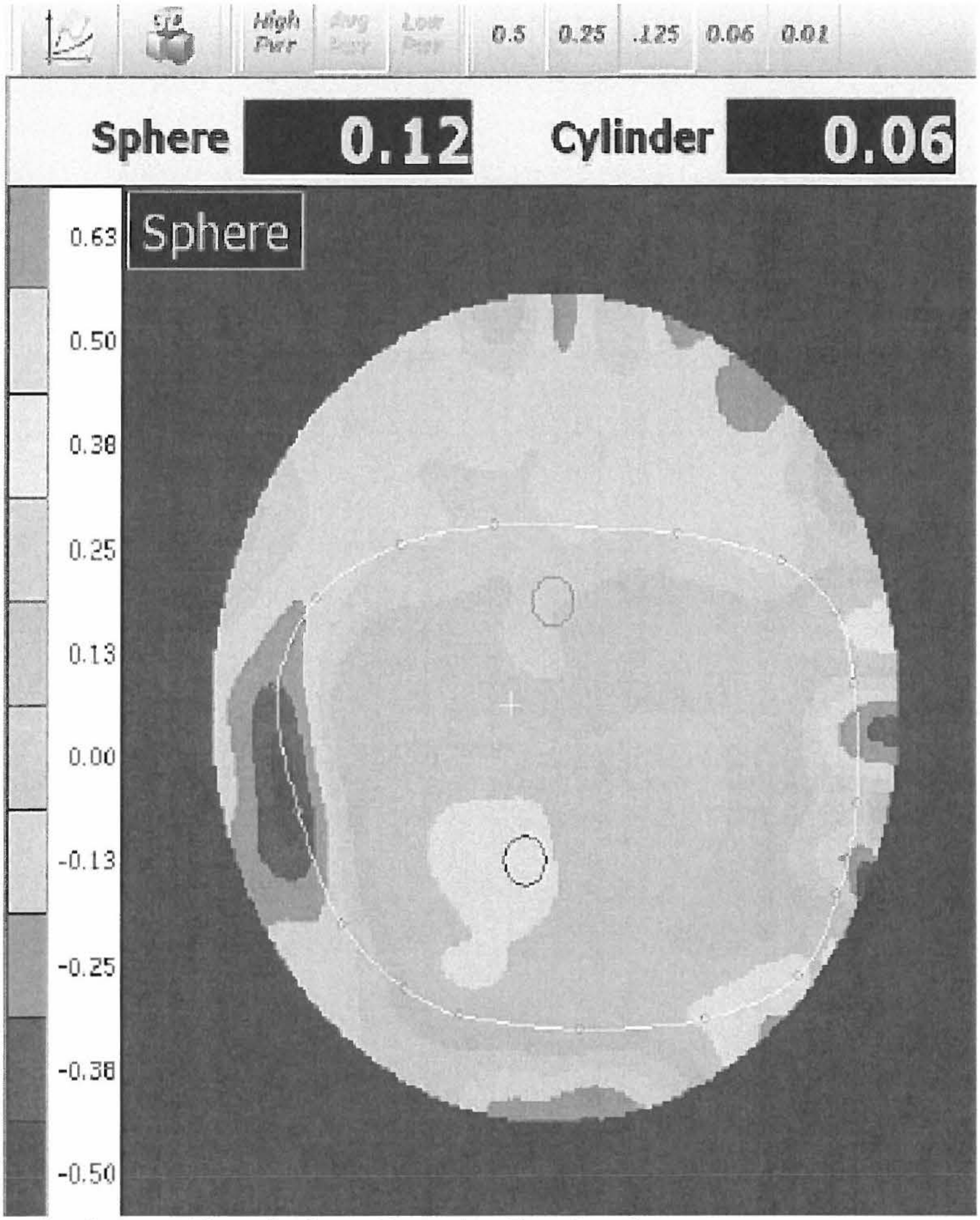
Hoya Sync 8 Plano Cut Lens- Mapped by Examiner 1



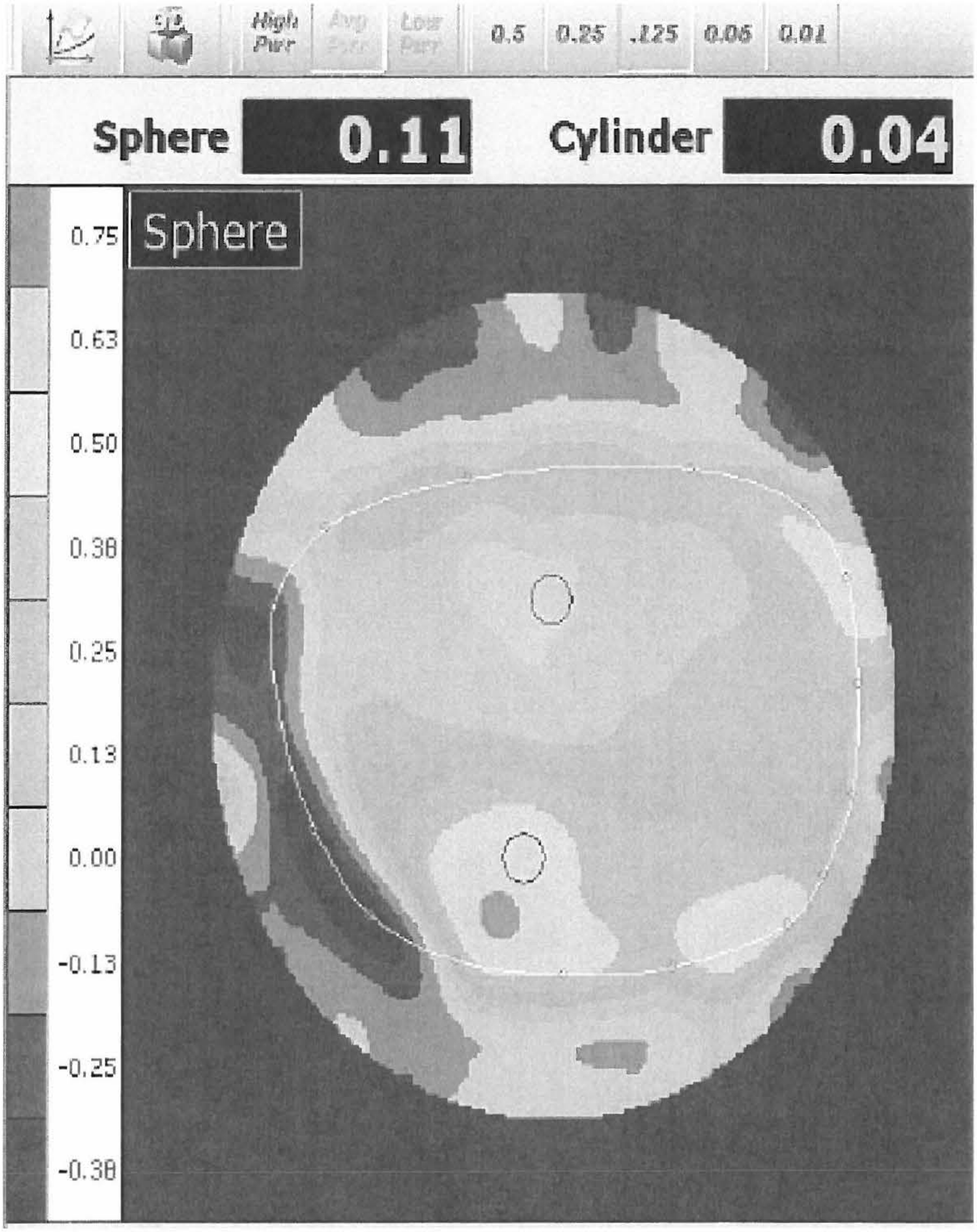
Hoya Sync 8 Plano Cut Lens- Mapped by Examiner 2



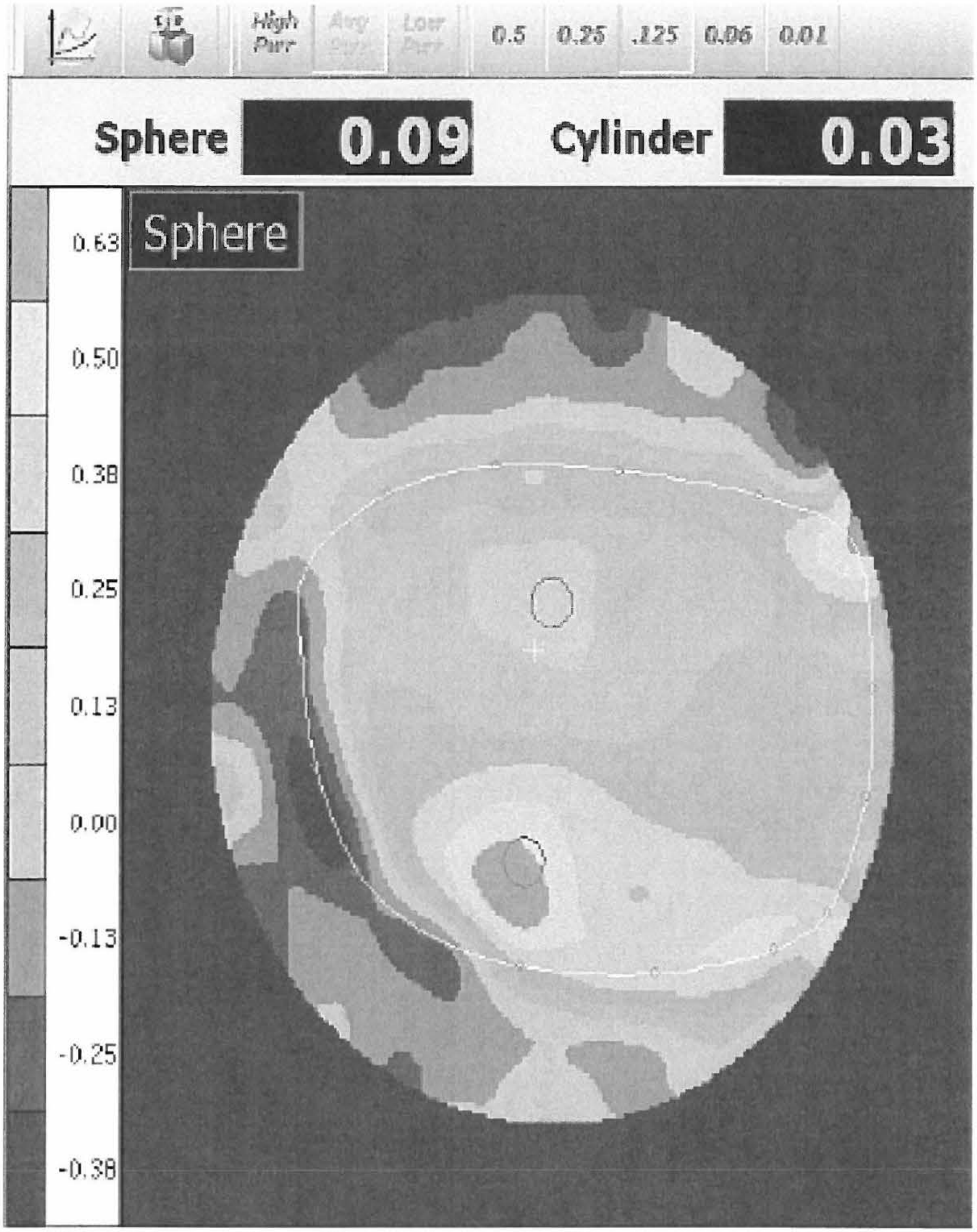
Essilor Eyezen+ Plano Cut Lens- Mapped by Examiner 1



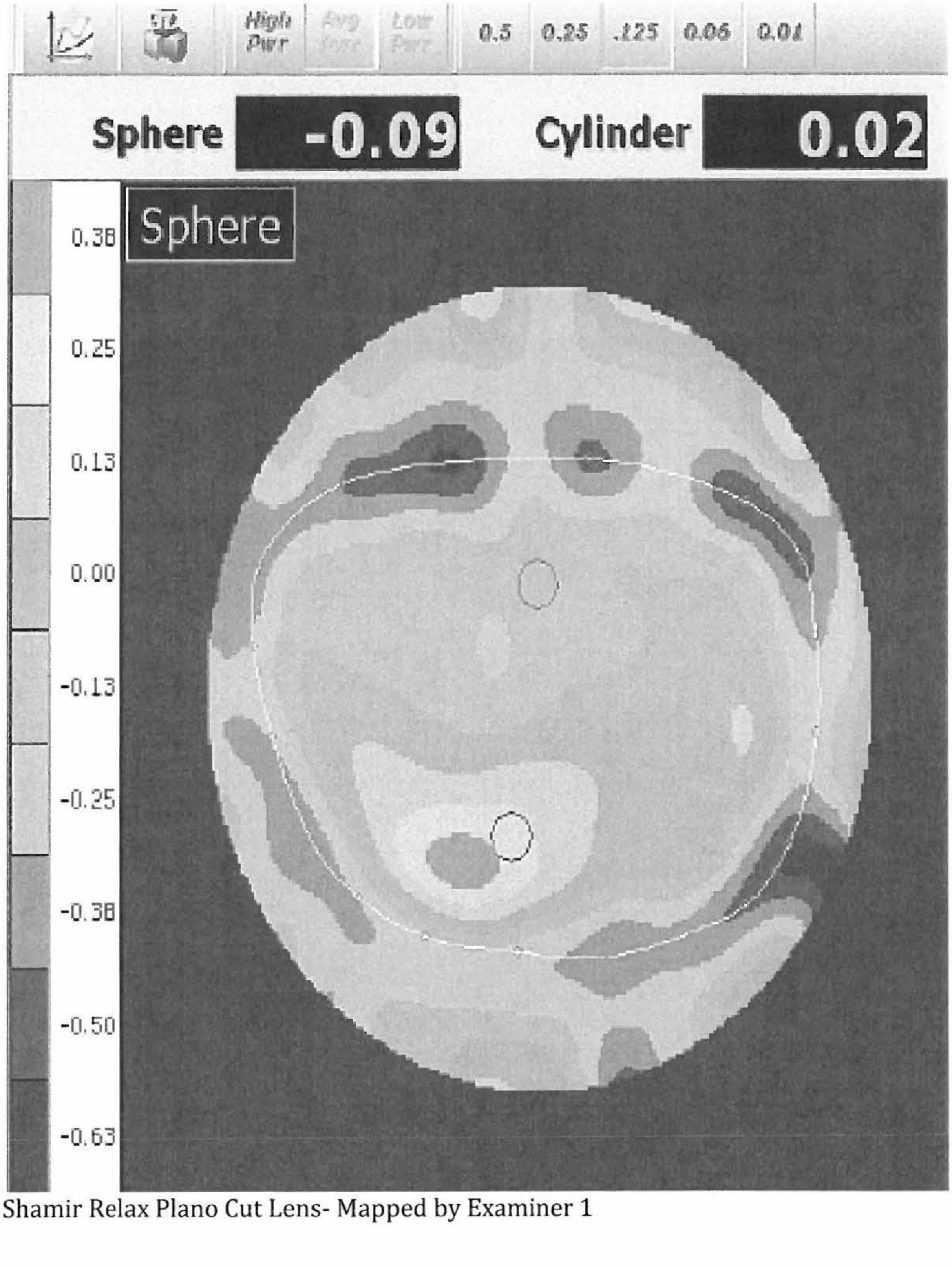
Essilor Eyezen+ Plano Cut Lens- Mapped by Examiner 2



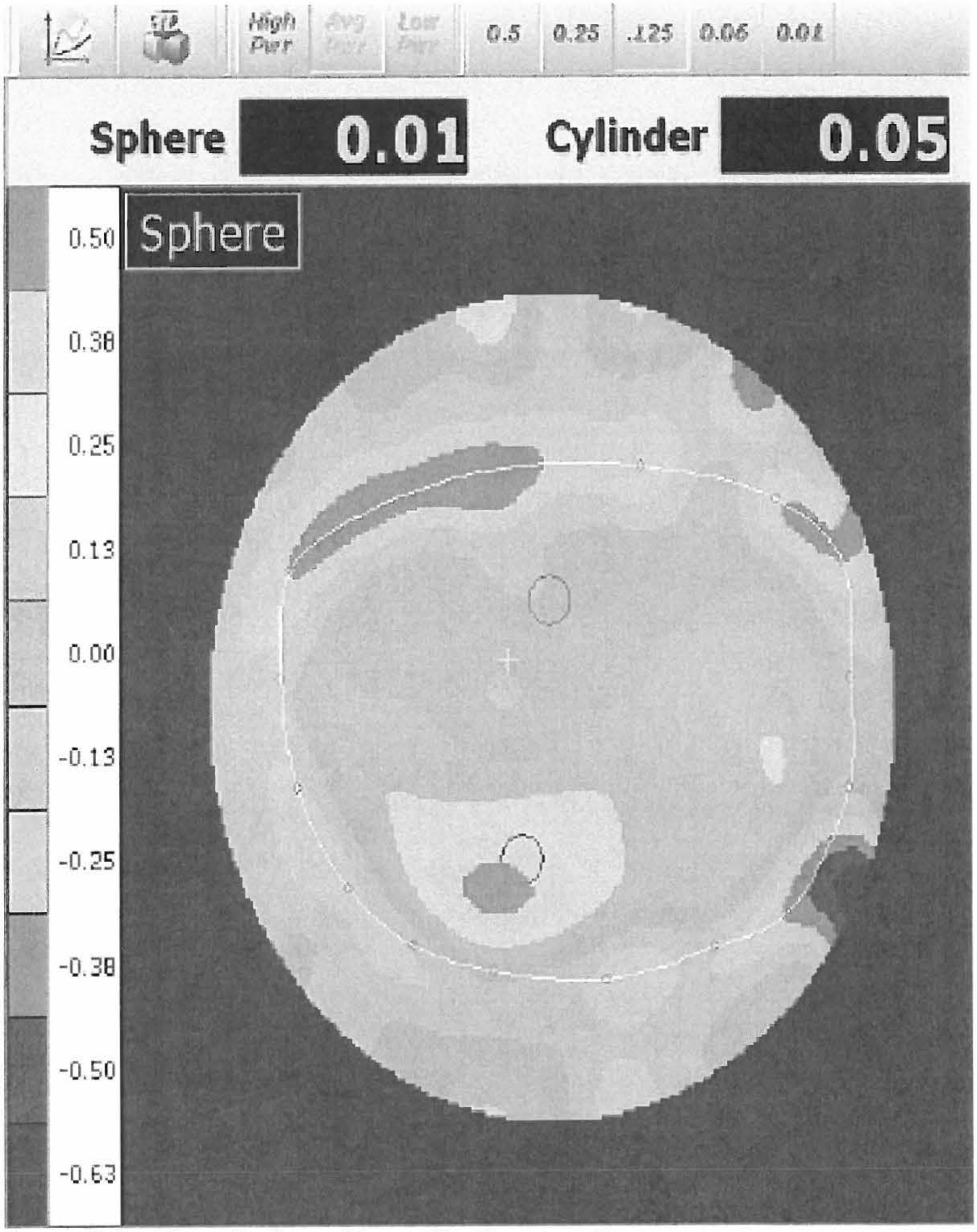
Hoya Sync 5 Plano Cut Lens- Mapped by Examiner 1



Hoya Sync 5 Plano Cut Lens- Mapped by Examiner 2



Shamir Relax Plano Cut Lens- Mapped by Examiner 1



Shamir Relax Plano Cut Lens- Mapped by Examiner 2