THE EFFECT OF PUPIL SIZE ON THE OVERALL AND PERIPHERAL SENSITIVITY OF THE HUMPHRIES VISUAL FIELD

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ABSTRACT

Ten optometry students performed a custom designed Humphries Visual Field in an attempt to measure overall sensitivity and peripheral sensitivity of field under three different pupil conditions: normal, mydriatic, and miotic. The results of the fields showed that a miotic pupil decreased the overall sensitivity by an average of 0.82 decibels (SD ±1.05), and a mydriatic pupil increased overall sensitivity by an average of 0.15 decibels (SD ±2.25). The peripheral sensitivity of the visual field was decreased by an average of 0.71 decibels (SD ±1.22) with a miotic pupil and increased by 0.84 decibels (SD ±2.73) with a mydriatic pupil.

INTRODUCTION

The Humphries Visual Field Analyzer has become the "standard" of care in diagnosing and providing follow-up care for patients with visual field defects. With the instrument's prevalent use, practitioners have discovered that many controversies exist regarding pupil size needed to provide most accurate data collection. Studies have been performed to evaluate the effects of pupillary construction and pupillary dilation on automated perimetry threshold in normal eyes (Lindenmuth et al). Pupillary constriction has been shown to lower threshold values by 0.67 decibels (Lindenmuth et al). Pupillary dilation lowered threshold values by 0.83 decibels (Lindenmuth et al).

This study attempts to evaluate the relationship between pupil size, overall sensitivity, and peripheral sensitivity of the visual field as measured by the Humphries Visual Field Analyzer.

METHODS

Ten optometry students, ages 21-26, had one eye subjected to each of the following conditions: mydriasis of 8.0mm achieved by one drop of 0.5% tropicamide and one drop of 2.5% phenylephrine, normal pupil size of 5.0-6.0mm, and miosis of 2.0mm achieved by one drop of 1.0% pilocarpine. To test the overall and peripheral sensitivity of each student's visual field, a Humphries Field Analyzer was used. Once the desired pupil size was reached, the student's refractive error was subjectively best corrected for the 33cm testing distance, and a 14-point custom designed field was performed. Eye tested (right vs. left) and the order of pupil size tested (mydriatic, normal, miotic) were randomly selected in each instance. (See Table 1.)

Patient #	VF #1	VF #2	VF #3	Eye Tested
1	normal	mydriatic	miotic	OD
2	normal	mydriatic	miotic	OD
3	normal	miotic	mydriatic	OD
4	mydriatic	mitoic	normal	OS
5	mydriatic	normal	miotic	OD
6	mydriatic	normal	miotic	OD
7	miotic	mydriatic	normal	OS
8	miotic	mydriatic	normal	OS
9	miotic	normal	mydriatic	OS
10	normal	miotic	mydriatic	OS

Table 1. Order of Pupil Size (Mydriatic, Normal, Miotic) and Eye (OD vs. OS) Tested

The average and standard deviation for each point of the visual field was calculated for normal, mydriatic, and miotic pupil size. (See Figure 1.) In order to assess overall sensitivity changes at each of the 14 points, both miotic and mydriatic average values were compared to the average normal pupil size sensitivity (a positive value denotes a decrease in sensitivity, and a negative value denotes an increase in sensitivity). (See Tables 2. and 3.) The peripheral sensitivity was evaluated by the same method employed for calculating overall sensitivity changes, except that only eight points (1, 2, 5, 6, 9, 10, 13, and 14) were used. (See Tables 4. and 5.)

RESULTS

The average sensitivity values and standard deviations for each of the three pupil conditions are shown in Figure 1.

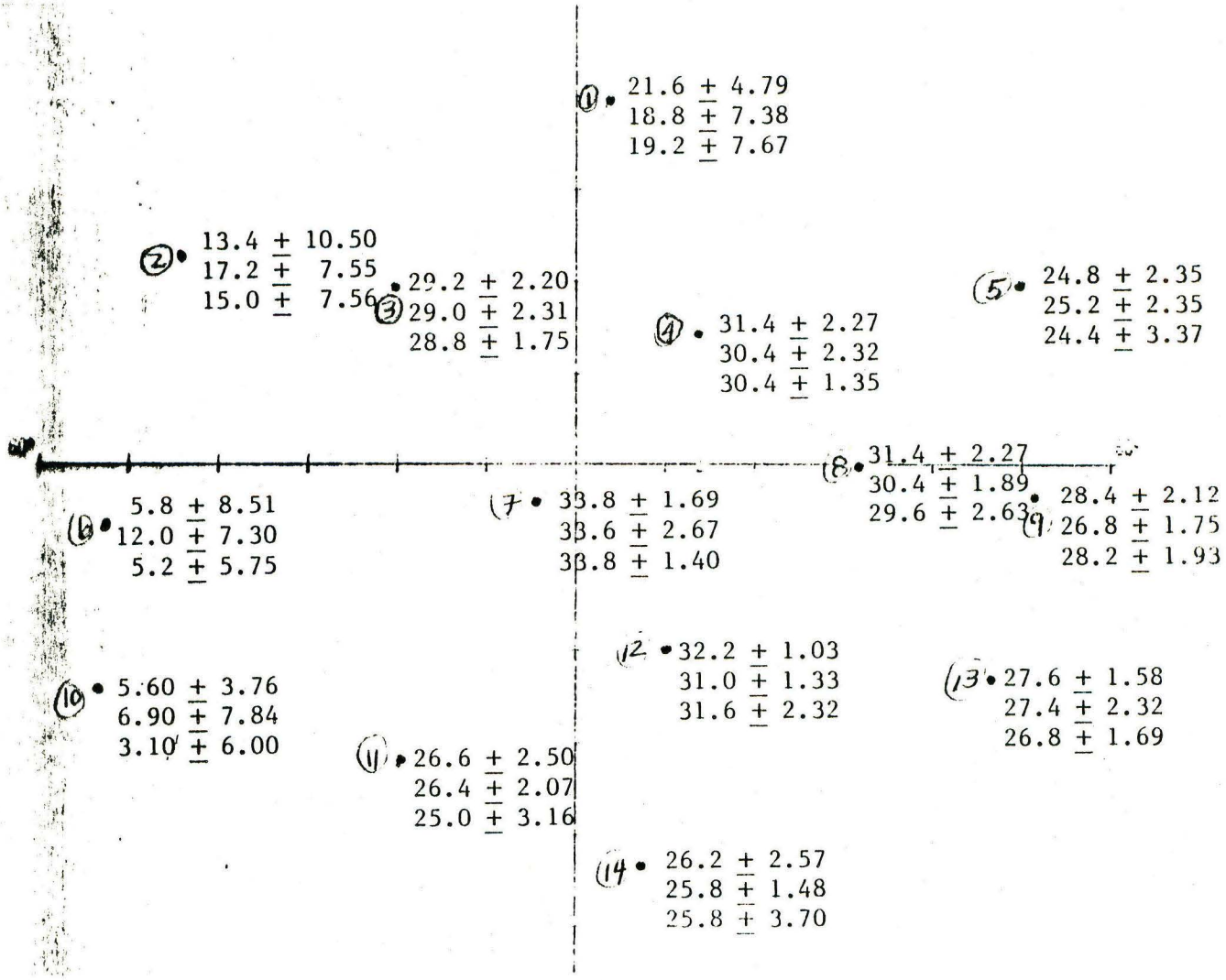

Figure 1. Sensitivity Values and Standard Deviations for
Normal Pupil Size (5.0-6.0mm)
Mydriatic Pupil Size (8.0mm)
Miotic Pupil Size (2.0mm)

Sensitivity, as compared to normal pupil size, was decreased by an average of 0.82 decibels (SD ±1.05) with a miotic pupil (See Table 2.), and it was increased by an average of 0.15 decibels (SD ±2.25) with a mydriatic pupil (See Table 3.).

Point	Change in Sensitivity (normal vs. miotic)	
1	+2.40	
2	-1.60	
3	+0.40	
4	+1.00	
5	+0.40	
6	+0.60	
7	0.00	$\bar{X}$ = +0.82 decibels
8	+2.20	SD = ±1.05 decibels
9	+0.20	
10	+2.50	
11	+1.60	
12	+0.60	
13	+0.80	
14	+0.40	

Table 2. Comparison of Normal and Miotic Pupil Sensitivity Values

Point	Change in Sensitivity (normal vs. mydriatic)	
1	+2.80	
2	-3.80	
3	+0.20	
4	+1.00	
5	-0.40	
6	-6.20	
7	+0.20	$\bar{X}$ = -0.15 decibels
8	+1.80	SD = ±2.25 decibels
9	+1.60	
10	-1.30	
11	+0.20	
12	+1.20	
13	+0.20	
14	+0.40	

Table 3. Comparison of Normal and Mydriatic Pupil Sensitivity Values

The peripheral sensitivity of the visual field was also affected by pupil size. A miotic pupil decreased sensitivity by an average of 0.71 decibels (SD ±1.22) (See Table 4.), and a mydriatic pupil increased sensitivity by an average of 0.84 decibels (SD ±2.73) (See Table 5.).

Point	Change in Sensitivity (normal vs. miotic)	
1	+2.40	
2	-1.60	
5	+0.40	
6	+0.60	$\bar{X}$ = +0.71 decibels
9	+0.20	SD = ±1.22 decibels
10	+2.50	
13	+0.80	
14	+0.40	

Table 4. Comparison of Normal and Miotic Sensitivity Values at the Periphery of the Visual Field

Point	Change in Sensitivity (normal vs. mydriatic)	
1	+2.80	
2	-3.80	
5	-0.40	
6	-6.20	$\bar{X}$ = -0.84 decibels
9	+1.60	SD = ±2.73 decibels
10	-1.30	
13	+0.20	
14	+0.40	

Table 5. Comparison of Normal and Mydriatic Sensitivity Values at the Periphery of the Visual Field

Conclusion

Pupil size does have an effect on the overall and peripheral sensitivity of the Humphries Visual Field. In order to standardize patient care, we recommend that each patient be measured with the same pupil size at each visual field evaluation to ensure consistency of data which is crucial to proper patient management.

References

Lindenmuth, Kim A., MD, Gregory L. Skuta, MD, Roya Rabbani, BS, and David C. Musch, PhD. "Effects of Pupillary Constriction on Automated Perimetry in Normal Eyes." Ophthalmology, Sept. 1989, Volume 96, pps. 1298-1301.

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