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A third preliminary study of the "true macular vision test"

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Abstract

The purpose of this thesis is to make a comparison of the amount of anisometropia which was obtained by a septum technique at near utilizing alternate fixations with the standard 20/40 blur and equalization test at far.

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A THIRD PRELIMINARY STUDY OF THE "TRUE MACULAR VISION TEST"

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PURPOSE

The purpose of this thesis is to make a comparison of the amount of anisometropia which was obtained by a septum technique at near utilizing alternate fixations with the standard 20/40 blur and equalization test at far.

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TABLE OF CINTENTS

I. INTRODUCTION----------1

II. REVIEW OF THE LITERATURE ----------2-4

III. EXPERIMENTAL APPARATUS AND PROCEDURE ----------5

IV. RAW DATA ----------6-7

V. INTERPRETATION OF DATA ----------8

VI. REFINED DATA----------9

VII. STATISTICAL ANALYSIS ----------10-11

VIII DISCUSSION ----------12-13

IX CONCLUSION ----------14

X SUMMARY ----------15

XI BIBLIOGRAPHY ----------16

INTRODUCTION

This thesis will represent a comparison of the findings obtained from two anisometropic tests. These tests are the 20/40 blur and equalization at far and the " True Macular Vision Test " at the near point. The 20/40 blur and equalization test is one of the basic procedures used in the standard optometric analytical examination. The "True macular vision test" is a variation in the septum technique for the determination of anisometropia at a testing distance of ten inches. The (TMV) test was introduced by Dr. Jaques for the purpose of providing an easily applied test which would have the "use of both monocular fields as a binocular unit."

In order to evaluate a test it must be determined if it is: (1) testing the same function or functions as those tests to which we are comparing it to; (2) reliable and; (3) sufficiently valid.

This study was limited to determining if there exists a statistically significant difference between the results obtained by the T.M.V. Test for anisometropia and those obtained by the 20/40 blur and equalization test. This would fall under (1) above, assuming that if no significant difference was obtained, the same function would be considered to have been tested.

REVIEW OF THE LITERATURE

One of the most often used techniques for binocular testing of anisometropia is the 20/40 blur and equalization method. In using this technique, plus is added monocularly until 20/40 is blurred out, plus is then reduced monocularly to the 20/40 acuity level. Vertical prism is introduced before both eyes. Dissociation by this method lets the patient compare two images of the same target. Additional plus is added until both images are equally blurred. In the case where equality can not be reached it is standard procedure to permit the better acuity with the dominant eye.

Borish states, " if the pupils of the two eyes are of different size or if the refractive status is sufficiently different to introduce inequality of image size, the 20/40 blur and equalization test will not be effective." (2) (We assume he means valid).

Dorland Smith presented a technique of non-cycloplegic refraction and anisometropia determination which he called "cyclodamia". By placing +1.50 diopter spheres over the retinoscopic or "rough subjective refraction", (we assume the test was one that approximated the standard 7A.), acuity was equalized on 20/60 material. First one eye and then the other was covered briefly, and the acuity and the acuity compared. (Plus sphere was reduced before the eye of lesser acuity.) When the acuity was equal at the binocular 20/60 level, the +1.50 D spheres were removed alternately and the cylinder determined by the Jackson cross cylinder method. (8)

Binocular testing involving a septum for determining the refractive condition was produced by Turville. Called the Turville Infinity Balance Test, it is one of the best known septum techniques.

In its original form it consisted of a test chart, with two fields of letters or test objects spaced 60 mm apart, set at six meters and reflected to the patient from a mirror placed at three meters, this mirror bisected by a septum of three cm. width. One set of letters is seen with each eye. A black border about the chart is seen binocularly and allows peripheral unification although central unification is absent.

A determination of anisometropia can be made using this condition of binocularity.

Morgan states, "that accommodation can only compensate at the near point to .25 D for a difference in the two eyes, the precise equalization may be extremely important." He also found by the Turville method that the limit of variability statistically was, on the minus side -.20 D ± -.17 D an on the plus side, +.15 D ± -.09 D. (6)

" The point of interest in the Turville method", Morgan states, " is the fact that peripheral fusion is present although central fusion is absent." (6)

Brungardt writes of a case in which the Turville subjective technique eliminated a pseudo-amblyopia elicited by normal testing. The patient accepted more plus before the amblyopic eye by this method as compared with the monocular method. The acuity increased from 20/60 to 20/25 and was thought to be due to the OS monocularly over-accommodating with the refraction in place resulting in a blur; but under binocular conditions, he held that the OD set the pace for accommodation and allowed fair acuity with the OS. He also believes that his opinion can be supported by the over amount

of plus found on the static retinoscopy for the OD. Here the target was being fixated with the OS, through at least 4.50 D of blur. (3)

Miles supports the Turville method by stating, "binocular refraction is not valid in the absence of fusion." He maintains that whatever method of refraction is used it is important never to blur the dominant eye. By blurring the dominant eye, suppression of the eye is initiated, which leads to confusion and complaint. He states " in regard to balancing the sphere between the nonpresbyopic eyes of average dominance and equal acuity, the Turville technique is valuable." (4)

In recent work completed in December of 1965, (7) and May of 1966, (9) at Pacific University College of Optometry, it was determined that there were statistically significant differences between the results of the anisometropia measured by Jaques method and that of the #14A and #21 monocular tests. Both reports stated that subjects found it easier to detect small changes in lens power with the T.M.V. test.

PROCEDURE AND EXPERIMENTAL APPARATUS

Twenty prepresbyopic subjects were selected from the student body of Pacific University College of Optometry. The only criteria used in selecting these subjects was that they be capable of standard acuity at 20 feet and at 10 inches. The cylinder correction was obtained with the Jackson Cross cylinder test.

The tests were administered in immediate succession on the same Bausch and Lomb Greens' refracter. The order of the testing was always the same, the 20/40 blur and equalization followed by the " True Macular Vision" test.

The 20/40 blur and equalization was taken as in the standard P.U. analytical examination. The target used was 20/40 Snellen acuity chart projected at 20 feet. Plus was increased monocularly until one or two letters could be read. Two prism diopters base up was placed before one eye and two prism diopters base down before the other, the two targets were then compared and equalized.

The " True Macular Vision Test". An opaque plastic septum (6" X 7") was placed on the reading rod; the double, reduced Snellen target with a separation of 8.9 centimeters was placed at 10" or 25.4 cm. Illumination was equalized on both sides of the target and a +4.00 diopters was added over the #7 to allow for the target distance, and the subject was checked for standard acuity. Plus was added until the subject reported first blur of the 20/20 line and then alternate blur out of successive lines on the double Snellen chart. Plus was then reduced alternately until the subject reported equal clarity, thru maximum plus, for 20/20.

TABLE I

RAW DATA

Subject #		20/40 B&E	TMV Test
1.	O.D.	+1.25	+5.00
	O.S.	+1.50	+5.25
2.	O.D.	+0.25	+3.75
	O.S.	+0.75	+4.25
3.	O.D.	+1.50	+5.12
	O.S.	+1.25	+4.75
4.	O.D.	+0.25	+3.75
	O.S.	+0.25	+3.25
5.	O.D.	+0.50	+4.25
	O.S.	-0.50	+3.50
6.	O.D.	+2.00	+5.75
	O.S.	+3.75	+7.75
7.	O.D.	PL	+4.00
	O.S.	+0.12	+4.25
8.	O.D.	+1.00	+5.00
	O.S.	+1.37	+5.25
9.	O.D.	-1.25	+2.75
	O.S.	-2.50	+1.25
10.	O.D.	-2.50	+4.25
	O.S.	-2.50	+4.25
11.	O.D.	+0.75	+5.25
	O.S.	+1.00	+5.37
12.	O.D.	-3.37	-0.25
	O.S.	-4.00	-0.75
13.	O.D.	+0.50	+5.00
	O.S.	+1.00	+5.50
14.	O.D.	PL	+4.75
	O.S.	PL	+4.50
15.	O.D.	-3.50	+1.00
	O.S.	-3.75	+0.75

Table I (cont.)

Subject #		20/40 B&E	TMV Test
16.	O.D.	-8.75	-4.00
	O.S.	-8.25	-3.25
17.	O.D.	+1.00	+5.50
	O.S.	+1.00	+5.50
18.	O.D.	+0.75	+5.00
	O.S.	+0.75	+5.00
19.	O.D.	+1.25	+6.75
	O.S.	+1.50	+6.87
20.	O.D.	-0.37	+3.50
	O.S.	-0.75	+3.25

INTERPRETATION OF DATA

In order to subject the experimental data to a chi-square test we had to designate the direction of the anisometropia. This was done by algebraically subtracting the sphere before the right eye from the sphere before the left eye.

The table of refined data (table II) shows the amount of anisometropia obtained with the 20/40 blur and equalization and the amount of anisometropia obtained with the TMV test. This table also shows the comparative differences between the anisometropia of 20/40 blur and equalization and the TMV tests. This was obtained by algebraically subtracting the TMV anisometropia from the 20/40 blur and equalization anisometropia.

The data was subjected to the chi-square test to determine if the frequency of the differences obtained between the two tests was statistically significant.

TABLE II

Subject #	Refined 20/40	Refined TMV	Difference
1.	+0.25	+0.25	0
2.	+0.50	+0.50	0
3.	-0.25	-0.37	+0.12
4.	0	-0.50	+0.50
5.	-1.00	-0.75	-0.25
6.	+1.75	+2.00	-0.25
7.	+0.12	+0.25	-0.12
8.	+0.37	+0.25	+0.12
9.	-1.25	-1.50	+0.25
10.	0	0	0
11.	+0.25	+0.12	+0.12
12.	-0.37	-0.25	-0.12
13.	+0.50	+0.50	0
14.	0	-0.25	+0.25
15.	-0.25	-0.25	0
16.	+0.50	+0.75	-0.25
17.	0	0	0
18.	0	0	0
19.	+0.25	+0.12	+0.12
20.	-0.37	-0.25	-0.12

TABLE III

CHI-SQUARE TEST

		TMV TEST (-)	TMV TEST (0)	TMV TEST (+)	
	(+)	(1) 0	(2) 0	(3) 9	9
20/40 B&E	(0)	(4) 2	(5) 3	(6) 0	5
	(-)	(7) 6	(8) 0	(9) 0	6
		8	3	9	

Expecteds: $E_{cr} = \frac{(n_c)(n_r)}{N}$

(1) $\frac{(9)x(8)}{20} = 3.60$

(2) $\frac{(3)x(9)}{20} = 1.35$

(3) $\frac{(9)x(9)}{20} = 4.05$

(4) $\frac{(5)x(8)}{20} = 2.00$

(5) $\frac{(5)x(3)}{20} = .75$

(6) $\frac{(5)x(9)}{20} = 2.25$

(7) $\frac{(6)x(8)}{20} = 2.40$

(8) $\frac{(3)x(6)}{20} = .90$

(9) $\frac{(9)x(6)}{20} = 2.70$

E_{cr} = Value expected in a box located in a specific column and row

n_c = totals of the columns

n_r = totals of the rows

N = total number of cases

CHI VALUES

$$X^2 = \sum \frac{(E_{cr} - \text{actual finding})^2}{E_{cr}}$$

(1) $\frac{(3.6 - 0)^2}{3.6} = 3.60$

(2) $\frac{(1.35-0)^2}{1.35} = 1.35$

(3) $\frac{(4.05-9)^2}{4.05} = 6.05$

(4) $\frac{(2 - 2)^2}{2} = 0.00$

(5) $\frac{(.75 -3)^2}{.75} = 6.75$

(6) $\frac{(2.25-0)^2}{2.25} = 2.25$

(7) $\frac{(2.40-6)^2}{2.40} = 5.40$

(8) $\frac{(.90 -0)^2}{.90} = 0.90$

(9) $\frac{(2.70-0)^2}{2.70} = 2.70$

$\overline{29.00} = X^2$

degrees of freedom = (c-1)(r-1) = 4

c = no. of columns
r = no. of rows

For significance at the 5% level score = 9.488
For significance at the 1% level score =13.277

DISCUSSION

Reference to column 3 of Table II, shows that the amount of anisometropia obtained with the TMV test disagreed with the 20/40 blur and equalization test in 13/20 or 65% of the cases. Of these cases showing disagreement, 7, or 53.8% showed greater anisometropia than the 20/40 blur and equalization test, and 6, or 46.2% showed less anisometropia. The average difference in anisometropia between the two tests was found to be .12 diopters.

The frequency of differences in the anisometropia obtained between the two tests was subjected to the chi-square test and found to be significant to 1/10 of 1% level of confidence. The amount of difference obtained between the two tests was not treated statistically, but it would appear that the tests are not interchangable for the population as a whole. However a judgment would have to be made on the basis of a clinical decision as to what constitutes a significant amount of anisometropic difference which would warrant the substitution of the TMV test for the standard 20/40 blur and equalization test.

The number of subjects tested was only 20, however we tested to the .12 diopter thus giving the maximum, clinically available, sensitive values for the end point of each. Our resultant chi-score for this population of 20 was such that additional testing (enlarging the population) would not likely have substantially changed enough to alter our conclusion concerning the rejection of the null hypothesis; namely, that there is a significant difference between the functions being measured by these two tests.

It has been observed before in the papers of 1965 and 1966 that the TMV test was slower to administer than the standard anisometropic tests, but the subjects reported a smaller range of just noticeable difference in judgment of blur.

The subjects stated that the difference in target clarity with small changes in lens power was more easily detected with the TMV test. This could be attributed to the fact that the blur of the spherical lenses before the eyes is compounded by the distortion of the rotary prisms used in the 20/40 blur and equalization test, a distortion that is not present with the TMV test.

A problem encountered by two of the subjects (which resulted in our eliminating them from the population of those statistically examined), was that at ten inches thru approximatly +4.00 D over #7 the exophoria was high enough to permit superimposition of the two reduced Snellen targets. In the description of the TMV technique this problem was said to have been eliminated by the amount of lateral seperation of the targets, (8.9cm). This is apparently not true in all cases. Given a moderately wide P.D. and / or high base in duction recoveries, superimposition is possible. With a 6.5 centimeter P.D. and a target separation of 8.9 cm the base in duction recoveries need be approximately 9.5 prism diopters for superimposition to occur. We assume here that the TMV technique simulates infinity.

CONCLUSION

In this preliminary study of Dr. Jaques' "True Macular Vision" test compared to the standard 20/40 blur and equalization test, it was found that the frequency of differences of anisometropia obtained was statistically significant.

The null hypothesis tested in this study is as follows: The True Macular Vision tes and the 20/40 blur and equalization test are measuring the same function. Since this null hypothesis was not upheld, we conclude that two different functions were being tested.

As was found in other studies, a definite conclusion claiming the Jaques test is a better or superior test cannot be made until (1) a comparative reliability study of the Jaques test and of the 20/40 blur and equalization test is made and (2) a comparative validity study of both the tests is carried out.

SUMMARY

In summarizing we can state that:

(1) The frequency of differences of anisometropia obtained with the 20/40 blur and equalization and the TMV test was statistically significant on the basis of our dichotomous chi-square test.

(2) Subjects reported that small differences in target clarity with changes in lens power were more readily detected with the TMV test.

(3) Dr. Jaques' target design shows need for improvement as two subjects superimposed the two reduced Snellen targets, rendering the test useless.

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