Comparison of Horizontal Phorias and Fusional Vergance Ranges Measured on Computer Orthoptics Diagnostic Program with Standard Methods of Measurement

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INTRODUCTION

In recent years various computer programs have been developed for optometrists for use in diagnosing and treating various oculomotor anomalies. In 1985 Jeffrey Cooper O.D.,M.S.,F.A.A.O. developed such a package called Computer Orthoptics. Computer Orthoptics is a computer package which presents complex binocular and oculomotor stimuli for orthoptics testing and training. Computer Orthoptics contains a diagnostic program and a training program.

The Computer Orthoptics Diagnostic Program (CODP) was created to allow either a trained or non-trained technician to automatically measure horizontal and vertical phorias, stereopsis on random dot stereograms, fusional ranges and accommodative facility. Measurements are automatically recorded and may be printed for permanent storage and documentation. Computer Orthoptics has also been promoted because of the fact it creates better test, re-test repeatability. Extensive study has not been to compare measurements obtained using CODP with standard methods.

The purpose of this paper is to measure horizontal phorias at 20" using the standard in phoropter Von Graefe method and compare this measurement with the measurement obtained using each of three targets on the CODP. The measurements were made on 30 subjects with ages ranging from 20-30 years old.

Comparison of fusional vergance range measurements at 20" using the standard in phoropter Risley prisms will also be made to fusional vergance range measurements using each of four CODP targets. These measurements will be made on the same 30 subjects.

MATERIALS AND METHODS

-Atari 800 XL Home Computer
-NEC Color Moniter
-Computer Orthoptics Diagnostics Program
-Red/Blue Anaglphic glasses
-AO Phoropter
-AO Nearpoint Rotochart with 20/20 block of letters target and "Keep this row single" column.
-AO Nearpoint rod
-30 subjects ages 20-30yrs. old

Phorias and Fusional Vergance Ranges are measured on each subject first using the CODP program. The CODP cartridge is inserted into the Atari 800 XL home computer. The first measurement to obtain is the subjective angle (phoria), thus the appropriate number on the keyboard is pressed in order to get to the subjective angle program. The subject is then seated 20" from the computer screen and instructed to wear Red-Blue analglyphic glasses. The examiner then measures the phoria using one of three targets (1) Cross, (2) Horse, (3) Car. The subject, using a joy stick, is instructed to first put (1) the cross in the box, then (2) put the horse in the box and (3) put the car in the box, thus three phoria measurements are made. The computer displays each of theses measured values and they are then recorded. The size of the targets used are:

(1) Car - 7 degrees 12' x 16 degrees
(2) Horse - 2 degrees 10' x 6 degrees
(3) Cross and Box - 4 degrees

After phoria measurements are obtained fusional ranges are measured. The subject again seated 20" from the screen is instructed to wear the Red-Blue glasses and is given the joystick. The examiner then measures the fusional vergance ranges using one of four targets. These four targets are:

(1) Car - 7 degrees 12' x 16 degrees
(2) Horse - 2 degrees 10' x 6 degrees
(3) "One" - 2 degrees 10' x 6 degrees
(4) RDS - 14 degrees x 4 degrees 30'

To measure fusional ranges the subject is instructed to push the trigger button to start and is to try to keep the object single. If it doubles the subject is to push the trigger button again. The subject is to push the trigger button again and is instructed to try to make the object go back to single. When the object becomes single the trigger button is depressed once again. This procedure first measures BI vergances. BO vergances are then measured in the same manner. The measured values are displayed on the screen and recorded by the examiner.

After the CODP values are measured Von Graete phorias are measured using an AO phoropter with a 20/20 square of letters @ 20". Finally BI and BO vergances are measured @ 20" using a "Keep this row single" line. The complete process was performed on each of 30 subjects and the results were recorded and statistically analyzed.

RESULTS

(See Table 1)

Subjective Angle

Comparison of Von Graefe phoria with :	Correlation Coefficient (r)
1) Cross Target	.5087
2) Horse Target	.4397
3) Car Target	.4077

Fusional Vergance Ranges

Comparison of:	Correlation Coefficient (r)
1) "One" BO Break (BOB) with BOB on Risley Vergances (RV)	.1517
2) "One" BO Recovery (BOR) with Risley (BOR)	.4258
3) "One" BI Break (BIB) with Risley (BIB)	.4036
4) "One" BI Recovery (BIR) with Risley (BIR)	.0898
5) Horse (BOB) with Risley (BOB)	.2521
6) Horse (BOR) with Risley (BOR)	.4120
7) Horse (BIB) with Risley (BIB)	.2155
8) Horse (BIR) with Risley (BIR)	.1507
9) Car (BOB) with Risley (BOB)	.0409
10) Car (BOR) with Risley (BOR)	.0251
11) Car (BIB) with Risley (BIB)	.3192
12) Car (BIR) with Risley (BIR)	.0739

13) RDS (BOB) .2553
with Risley (BOB)

14) RDS (BOR) .2536
with Risley (BOR)

15) RDS (BIB) .1418
with Risley (BIB)

16) RDS (BIR) .0535
with Risley (BIR)

DISCUSSION

Correlation between phorias measured with Von Graefe technique compared to phorias measured with targets on the CODP using Pearson (r) or product moment correlation was not substantially high. The hightest value of (r) was .5087. This value was the (r) found when comparing the cross target with the Von Graefe technique. Values (r) of .4394 and .4077 were found using the horse target and cross target respectively.

A reason for lack of high correlation between the CODP method and VG method may be explained by the fact that careful standardizaton between the two methods may not have been made when the CODP was compiled. Background luminance should also be considered as a factor influencing correlation. The background luminance was different in the two rooms in which the measurements were made.

Order of testing could also influence results. The oculomotor testing using one method could "fatigue the subject`s visual system" thus resulting in unreliable data when the other method is tested.

Other variables which may account for lack of high correlation include "patients interpretation of test" and target size. The large target cross was found to have the highest correlation. The smaller the target size the lower the correlation.

Risley fusional vergance ranges compared with fusional vergance ranges using the computer orthoptics targets were found to have low correlation. In most cases mcuh lower than the way the phorias correlated. This low corrlaton can also be accounted for by the fact that there may have been lack of careful standardization. Target size, background luminance and order of testing are other variables which must be considered when analyzing the correlation.

Fusional range correlation was generally much lower than the phoria correlation because of a few obvious reasons. One primary reason is because of mechanical difficulties. Patients were having problems using the joystick during vergance range testing. Very often the target would not stop moving when the joystick button was initially depressed. The button would have to be pushed one or two more times. This caused high values on the breaks and low values on the recoveries. Patient reaction time and interpretation of test are other variables which must be considered. Often time patients were confused and unsure when to push the joystick botton. Patients reported that the targets would alternate between double and single thus resulting in an erroneous vergance measurement.

Conclusion

The in phoropter method of measuring phorias (Von Graefe) does not highly corelate with phoria measurements made with computer orthoptics. The cross target has the highest correlation. The optometrist doing VT with computer orthoptics should be aware that the data obtained using CODP may be different than if he obtained the data using in phoropter techniques. If the optometrist does wish to use CODP because of convenience and practicality purposes, it is advised that the car target be used to make the phoria measurement.

The in phoropter Risley method of measuring fusional vergance ranges has a very low correlation with the measurements made with computer orthoptics targets. It is not recommended that optometrists use fusional vergance range diagnostic data from the computer orthoptics program. Mechanical difficulties with the joystick and patient interpretation and reaction were a few of the factors discussed that caused possible erroneous fusional verance range values. Risley vergances should be the method of choice when measuring fusional vergance ranges.

Reference

Manual for Computer Orthoptics and Therapeutic Programs, Jeffrey Cooper O.D. M.S. F.A.A.O

CUP

Phoropter

Subject	Subjective Angle			Fusional Ranges								Subj. Angle	Fusional Ranges	
				ONE		Horse		Car		RDS				
	cross	horse	car	BO	BI	BO	BI	BO	BI	BO	BI	Phoria	BO	BI
(1) Mary Bolo	¢	¢	1exo	2/0	3/2	10/6	10/5	47/44	10/7	6/3	12/10	¢	36/12	18/12
(2) Tonya Leach	1exo	¢	¢	63/56	5/1	55/52	10/4	47/41	14/6	30/20	8/5	3exo	40/40	20/14
(3) Sam Skovira	1exo	¢	¢	24/25	1/0	13/9	4/1	20/16	6/3	8/5	10/7	1eso	26/20	10/6
(4) Mark Simard	1exo	2exo	2exo	41/36	4/1	22/15	11/2	10/5	19/2	1/0	9/3	3exo	40/40	16/10
(5) Sheldon Smith	¢	1exo	1exo	34/33	14/7	34/21	16/8	47/25	16/11	35/34	8/9	3exo	26/20	36/18
(6) Michelle Vella	1exo	1exo	1exo	2/0	4/1	43/4	13/0	47/7	18/0	46/10	4/0	2eso	32/27	16/14
(7) Rhonda Graham	2exo	1exo	1exo	3/0	3/-1	10/1	14/9	14/6	16/9	4/4	6/5	4exo	20/16	16/14
(8) Linda Vanderberg	2exo	2exo	3exo	5/1	2/-3	24/20	14/10	23/8	16/11	28/26	4/5	4exo	12/6	14/12
(9) Mary-Jo Horn	1exo	¢	¢	2/0	2/-3	52/8	14/0	47/10	12/-11	20/14	16/12	4eso	39/28	16/14
(10) Ken Pilon	1exo	2exo	1exo	14/14	3/1	31/16	11/4	26/6	18/3	14/13	4/2	1eso	24/20	12/10
(11) Cindy Fritzler	3exo	2exo	2exo	4/-1	5/4	6/3	3/3	15/8	6/4	14/12	5/3	9eso	36/18	12/9
(12) John Pemberton	¢	¢	¢	3/2	2/1	10/6	3/2	28/20	10/4	15/10	12/8	7exo	30/16	18/10
(13) Bill Bice	¢	2exo	1exo	6/4	1/-2	2/1	3/2	20/6	6/4	3/2	4/1	¢	20/18	16/14
(14) John Jacobi	1exo	1exo	1exo	3/2	2/1	10/6	3/2	10/3	4/3	6/4	10/4	¢	30/16	12/9
(15) Dave Douglas	¢	¢	¢	7/2	4/1	20/6	5/2	6/3	10/4	20/10	16/8	¢	34/18	28/16
(16) Carolee Burns	1exo	1exo	2exo	9/2	3/0	26/14	12/2	24/20	13/8	55/55	9/6	1exo	21/15	15/0
(17) Lynette Fox	1exo	1exo	2exo	9/8	7/4	26/21	12/10	23/22	14/7	67/66	5/6	6eso	18/12 ¢	6/4
(18) Scott Schumacher	¢	5exo	7exo	3/0	1/-1	11/8	2/2	47/30	10/9	22/9	10/9	4exo	34/14	12/4

(cont'd)

CUDP

Phoroptor

Subject	Subj. Angle Cross	Subj. Angle Horse	Subj. Angle Cat	Fusional Ranges ONE BO	ONE BI	Horse BO	Horse BI	Cat BO	Cat BI	RDS BO	RDS BI
2) Dario Hollingsworth	1exo	1exo	1exo	9/2	5/4	32/9	20/11	23/20	16/8	15/14	17/18
3) Diane Gotta	3exo	1exo	~~2exo~~ ¢	9/8	10/1	35/6	18/9	27/4	19/11	60/58	16/13
4) Carol McMillan	¢	¢	¢	3/0	7/0	9/-2	5/2	33/27	12/6	11/11	10/7
5) Carol Brunner	¢	¢	¢	3/1	3/1	55/36	11/6	47/18	7/2	56/56	9/7
8) Brad Taylor	¢	¢	¢	3/0	5/1	21/15	6/2	28/24	11/1	61/60	6/3
9) Joe Myers	1exo	1exo	¢	3/0	10/6	41/30	30/11	31/16	15/10	9/9	10/11
10) Ted Redmond	2exo	2exo	¢	3/0	11/-4	31/6	19/10	40/7	19/12	12/10	8/5
11) Leigh Goodfellow	1exo	1exo	2exo	2/1	4/3	40/34	15/5	47/28	17/10	21/5	14/80
12) Jay Abrios	1exo	1exo	¢	11/3	14/6	54/46	19/10	47/45	20/8	17/17	10/11
13) Rick Cullitti	¢	¢	1exo	3/-5	5/1	3/0	3/1	7/0	4/1	41/39	15/13
14) Mark Sanjiato	1exo	1exo	¢	11/5	1/-5	4/4	4/2	20/8	12/4	15/15	16/11
15) Ricky Scalfani	1eso	1eso	¢	3/-2	4/5	5/-1	4/1	3/1	4/-1	30/15	14/13

Phoroptor

Subject	Sub-Angle Phoria	Fusional Ranges BO	Fusional Ranges BI
2) Dario Hollingsworth	1exo	21/15	24/15
3) Diane Gotta	¢	34/24	16/14
4) Carol McMillan	1exo	18/12	30/18
5) Carol Brunner	1exo	14/15	12/8
8) Brad Taylor	9eso	40/37	12/10
9) Joe Myers	4eso	14/12	12/11
10) Ted Redmond	5exo	30/24	14/12
11) Leigh Goodfellow	1exo	40/38	18/9
12) Jay Abrios	6exo	31/30	14/12
13) Rick Cullitti	4eso	32/12	10/6
14) Mark Sanjiato	1eso	32/18	12/8
15) Ricky Scalfani	9eso	40/40	14/12