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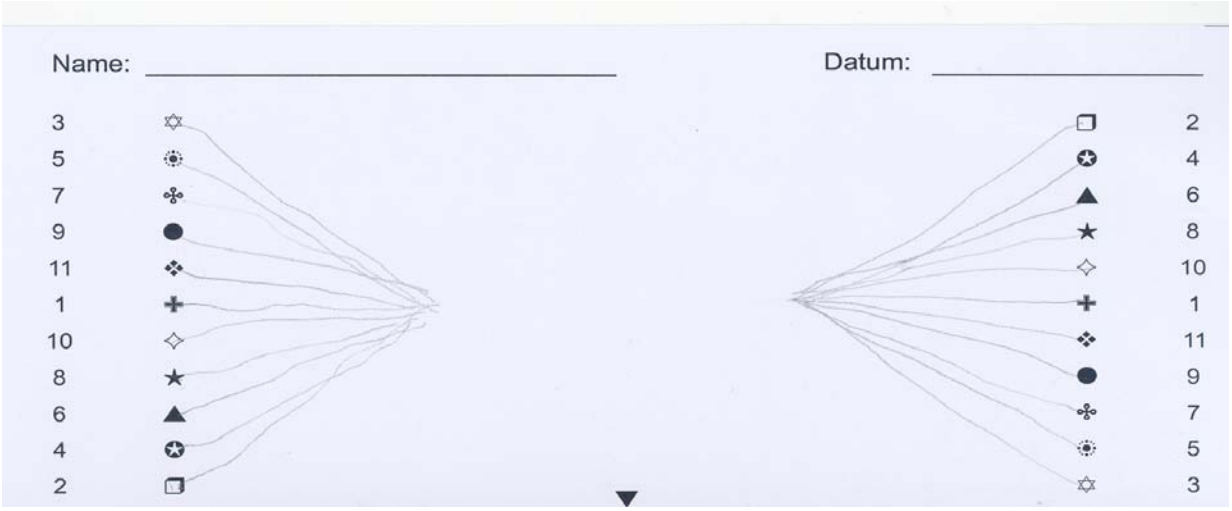
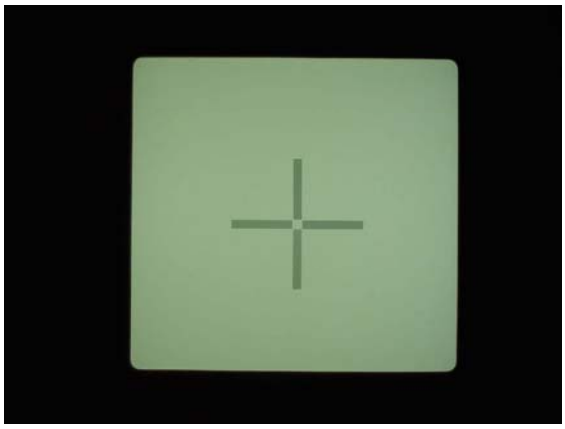
Scholarly Work 2004

Can phorias be determined by using Van Orden Star drawings (VOSd) equal as in the use of the Pola-Test





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1. Introduction of subject

Van Orden Star drawings (VOSd) used to be a quite popular procedure often used in visual-training sessions since their introduction more than 30 years ago by Van Orden, M.E. [(1)] . After a time of enthusiasm the procedure was more and more replaced by other tests and training methods. Nowaday, with the new generation of European Optometrists performing visual training with their patients, the VOSd is experiencing a kind of a revival in Europe.

This is the fact for our interest in this topic. Since European Optometrists are skilled in the use of the Polatest we decided to compare the two procedures in the area of phoria-screening.

VOSd are primarily used to collect more information about the patient's visual behavioral pattern. Commonly the VOSd is used to find out about the patient's spacial orientation. Since the lines of the VOSd of the right and left eye meet in a certain point at a certain distance from the center of the drawing one can be tempted to interpret the binocular status of the subject. As certain visual training specialists trust this test to evaluate the phoric state of the patient and take it as reference to eventually submit the subject to a visual training procedure, we found it interesting to check the reliability of this test to detect phorias.

Our goal is to assess the ability of the VOSd procedure as screening method to detect phorias. All other aspects of spacial orientation or psychological evaluation through VOSd are not taken into account. We decided to label the following null-hypothesis:

2. Hypothesis

Van Orden Star drawings (VOSd) will display the quality of phorias equal to the Polatest**.**

The goal is to establish a statistical significance by comparing the results of the two methods. The main concern of the study is not a quantitative but rather a qualitative determination of the existence and direction of phorias.

3. Description of VOS

VOSd are routinely used in the Optometric practice to receive a better understanding of the patient's visual behavior. The VOSd probes the way one perceives and mentally represents the world around himself. The test gives us a two dimensional picture of how the patient operates in a three dimensional space [(4+7)]. Therefore VOSd can be used in three ways. First it allows to get an evaluation of the patient's

visual behavior. Then it permits to train his visual perception ability and finally to re-evaluate his visual behavior after visual training sessions have taken place.

Different authors have suggested different routines of instruction. Van Orden [(1)] and Lesser [(2)] stated: "the patient has to watch the pencil points and move them simultaneously toward each other and to stop when they appear to meet.". Mac Donald [(3)] even used a less structured approach: "Draw the two pencils toward one another until they look like they are touching one another. At that moment take away your pencils from the paper."

On our behalf we decided to incorporate the methods suggested by Kaplan [(4)] and OEP [(5)] which lead to the developed patient education form (Appendix I). The bioptor of our choice is the Bernell-O-Scope.
According to the recommendations of Van Orden and Keystone [(6)], the target pattern used was a white paper with two columns of figures, such as stars, dots, crosses, etc (Figure 1+2). Columns are composed of eleven figures placed 140mm apart. The vertical orthophoria line is connecting the middle figures of the two opposite columns (BB Figure 3). The position of the horizontal ortho-lines are discussed controversial among optometrists using the VOSd. Of course the type of optics incorporated in the biopter used is essential in this discussion. Van Orden used primarily the Keystone Correct-Eye-Scope with an optic-center-separation of 85.00mm. With this device he defined the ortho-line to be 77.00mm between the apices of the star [(5)].

According to Collier ortholines are located exactly in the geometrical center between the temporally located figures and the center of the test sheet [(10)]. This approach equals a separation of the apices of the star of 70.00mm. Since this method is the most commonly used in Europe our statistics are based on this assumption.

Nevertheless we thoroughly inspected the biopter of our choice (Bernell-O-Scope). The instrument consists of two lenses mounted in 61.00mm distance to each other. The power of the lenses is +5.00 diopters with a temporal decentration of 17.00mm per lens resulting in an optic-center-separation of 95.00mm[(11)].

According to our calculations and optically correct drawings (Figure 4) the patients pupillary distance has no effect on the position of the ortho-lines.

Scientifically correct would be the assumption that the ortho-lines are exactly at a 95.00mm, in other words at the object focus. Taking in account the convergence induced by the near-feeling from the instrument, we agreed with van Orden and Collier to shift the ortho-line more centrally at 70.00mm (AA Figure 3).

Figure 1 : Representation of a blank VOS sheet.

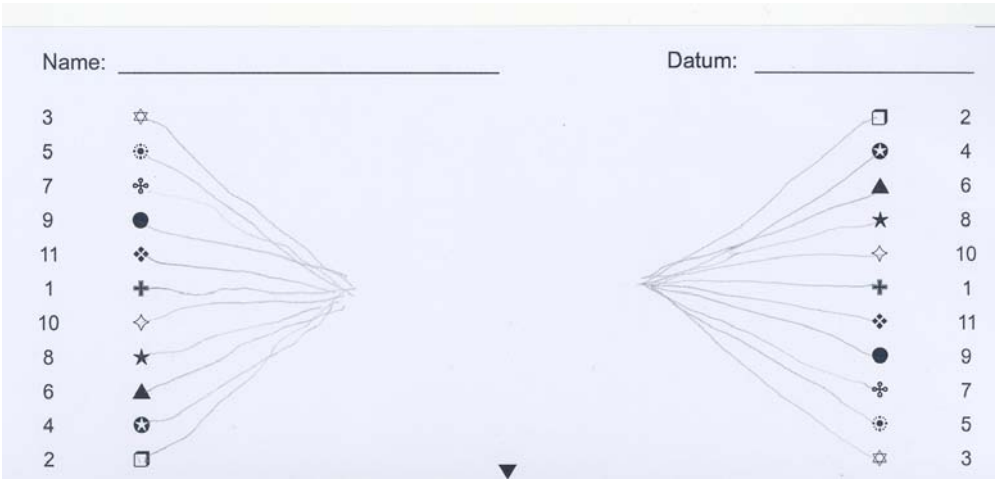


Figure 2 : VOS sheet with drawings.

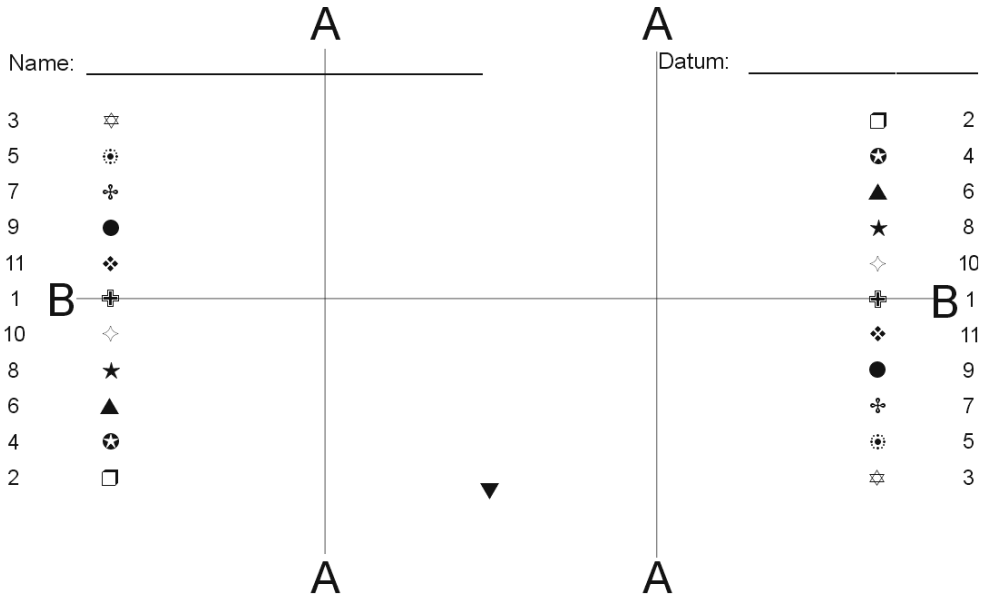


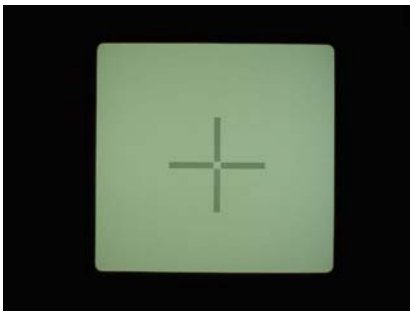
Figure 3 : Representation of the evaluation sheet with ortholines

Figure 4 : Bernell-O-Scope biopter.

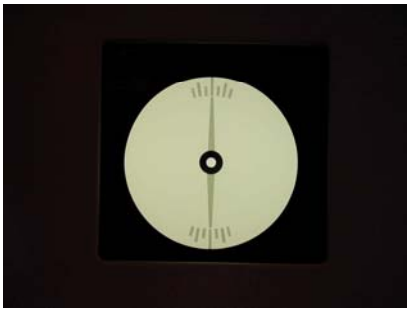
4. Description of Polatest [8+9]

The Polatest is a test for the evaluation of binocular vision elaborated by Dr Haase. The vision between both eyes is semi-dissociated by polarized lenses. This means that each eye can only see one part of the positive polarized figure-test, nevertheless the peripheral environment remained perceived simultaneously by both eye. The particular interest of Polatest is that it allows an overall understanding of binocular vision. Each test chart gives a proper information about the state of binocular perception :

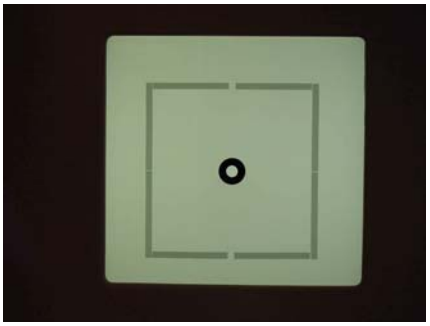
1. The cross test assesses the motoric component of the phorias. Vertical and horizontal lines of the cross can be both perceived in Panum's area. The deviation of axes is only noticed if one of the branches stays out of Panum's. Somehow the examinator has to stay careful with the interpretation of this test. If the patient has a long-standing fixation disparity (an extention of Panum's area), he may mimic an orthophoric. Actually a symmetric cross only means that the patient is muscularly relaxed, not that he's orthophoric.



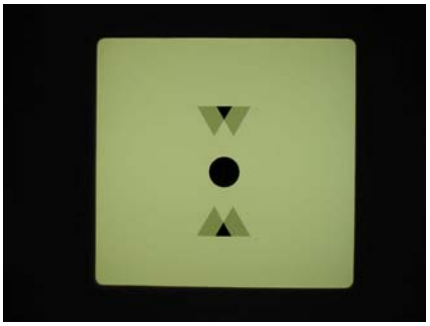
2. The pointer-test allows to measure the fixation disparity. The white point is seen by both eyes, the pointers by one eye and the scales by the other eye. As the point is seen binocularly in Panum's area, it stays single. The scales stay out of Panum's area, and the pointers in the area. This means that if you have a fixation disparity, the scales are not included in the area and are seen deviated. This shows the sensory phorias of the binocular perception. This test may also tell you if the patient has developed a new central correspondence. If you correct your patient at the cross and he's also centred at pointer-test, the central correspondence stays foveolar. At the contrary if the patient is centred at the cross and remains decentred at pointer-test, you can notice a modification of central correspondence.



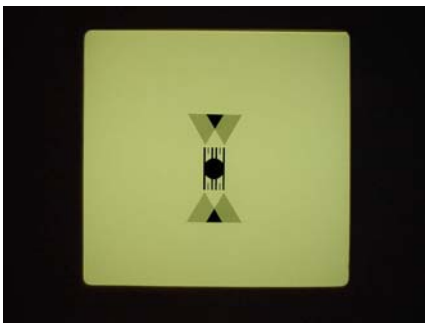
3. The bracket test may detect even greater Panum's extention. It is a particularly appreciated test to assess vertical phorias.



4. To refine the binocular check, it is then required to check stereopsis with triangle-stereo test. The examinator has to write down any delay or double vision in far or close stereo perception. Prisms have to be increased till immediate stereopsy close and far is present. Delays occuring in homonymous stereopsy (test seen further) highlight esophorias. In heteronymous stereopsy (test seen nearer) delay shows at contrary exophorias. If a delay is noticed in both direction, you should think about vertical deviations.



5. The stereo-valence test allows then to assess the balance between both eyes and to adjust this balance.



When all tests are totally corrected, the patient is supposed to have recovered a perfect foveolar binocular correspondence and in consequence a perfect depth perception. However, people with new central correspondence will have to wait some time to find foveolar correspondence again. This way, when fully corrected, you may

notice an inverse phoria than the one corrected at the cross before. An esophoric may look like an exophoric.

As the Polatest takes in account the sensory components of phorias, the full Polatest correction may usually be higher than the one measured by totally dissociated test like Von Graefe or Maddox. This can be explained by the supposition that peripheral vision continues to have the foveola as central correspondence point even with fixation disparities. The associated phorias are this way omitted.

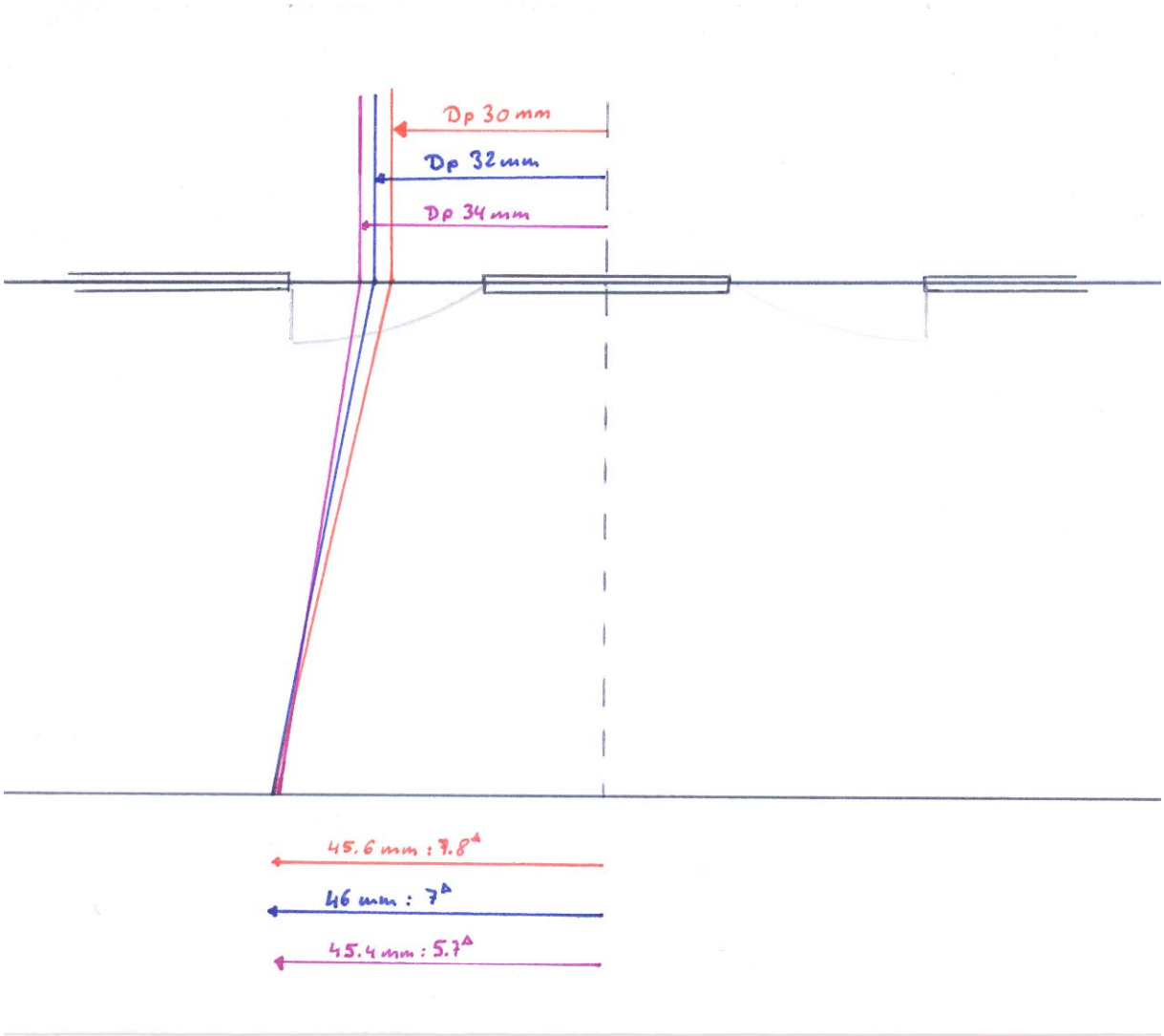
The above presention has the only aim to explain the way of thinking of Polatest. It is not our intention here to discuss about the accuracy of the whole method, and even less to debate about the polemic full-correction prismatic prescription requested by Dr. Haase.

In the purpose of this study, the Polatest has been taken as reference because it is for us in Switzerland a well-known and recognized test to detect phorias. For practical reasons, we decided to restrict ourself to the three more relevant tests : Cross, pointer and bracket-test. Our goal is then to compare these results with those of VOS.

5. Methodology of research

The study was conducted as a prospective multi-centered study. To rule out errors the testings took place in an identical environment at three different locations with identical instruments. The stereoscope used was the "Bernell-O-Scope" with standardized test-figures. Due to the location of test-sheet at the object focal distance of Biopter-lenses, and assuming the lenses are free of aberrations, the patient’s pupillary distance could be neglected to evaluate the phorias with the VOSd. The test-sheet had to be well centered on the tray to avoid bias of interpretation.

To interpret the results of the drawings, we elaborated two different transparent evaluation-sheets. The first evaluation is based on the so called “Collier Method” which assumes that the ortholines are located midway between the centre of the sheet and the lateral VOS figures. This places the ortholine at 35mm from the centre. We decided to check this plan of reference because of the expanding influence of Dr Collier’s way of thinking in Europe. Thus, this method appearing to us arbitrary or at the best empirical, we wanted to check the accuracy of the procedure taught in our countries.
As we noticed that this plan of reference lacks of scientifical basis, we tought it would be opportunate to check the method in another plan of evaluation. For this purpose, we then conceive a second sheet which refers to a purely optical basis. The ortholines are this time located 47.5 mm laterally from the midline. This correlates with the optical axis of each lens. In this case, we assumed that no physiological bias could interfere with the results. We will discuss again this point further.



Schematic representation of the way of the beams according our measurement of the prisms with the lensmeter. However, we used for our study PD of 95mm according to manufacturer datas.

The lateral deviation of the apex of the fan indicates us the lateral phorias. If the endings are more temporal to the ortholine, this means an exophoria; more nasal, it means esophorias. To evaluate the vertical phorias, we had then to draw a line perpendicular to the other vertical lines which pass through the left hand side tip of the fan. If the right hand side tip of the fan is above this horizontal line, we can notice an right hyperphoria; if below, we have then a right hypophoria.

The Pola-Test procedure will be: Cross-Test, Pointer-Test (for horizontal Phoria), Bracket-Test (for vertical Phoria). The Pola-Test-Type used in all three locations is

Pola-Test-Classic. The tests are produced and standardized by the Zeiss Company and used at a distance of 6m.

At each location 13 respectively 14 randomly chosen and voluntarily recruited participants have been tested once with each test. This way of testing simulated best the possible daily routine since in general there will not be multiple testings during one session. The participants must have binocular vision.

Preleminary instructions have been given to the patient before drawing a Van Orden Star are essential in getting comparable results. Therefore, we developed for the purpose of this study an instructions paper in order to assure consistency in patient education (Appendix I). An equivalent instruction sheet for the Polatest is also given to the patient (Appendix II).

First the pupillary distance has been measured then a subjective and objective refraction has been completed in order to avoid bias of ammetropia-induced phorias. Pola-Test binocular-tests have been conducted at the end of the refraction. The last test performed was the VOS drawing.

The Results have been written down as follows:

For the VOSd: Orthophoria/Esophoria/Exophoria/right Hyper- oder Hypophoria present.

For the Pola-Test: Orthophoria/Esophoria/Exophoria/right Hyper- oder Hypophoria present at Cross, Pointer and Bracket-Test.

The participants will be instructed for VOSd and Pola-Test with standardized advices and/or questions.

The statistical evaluation will include the number of negative false and positive false results of the VOSd compared to Pola-Test and the comparison of the two tests.

6. Results

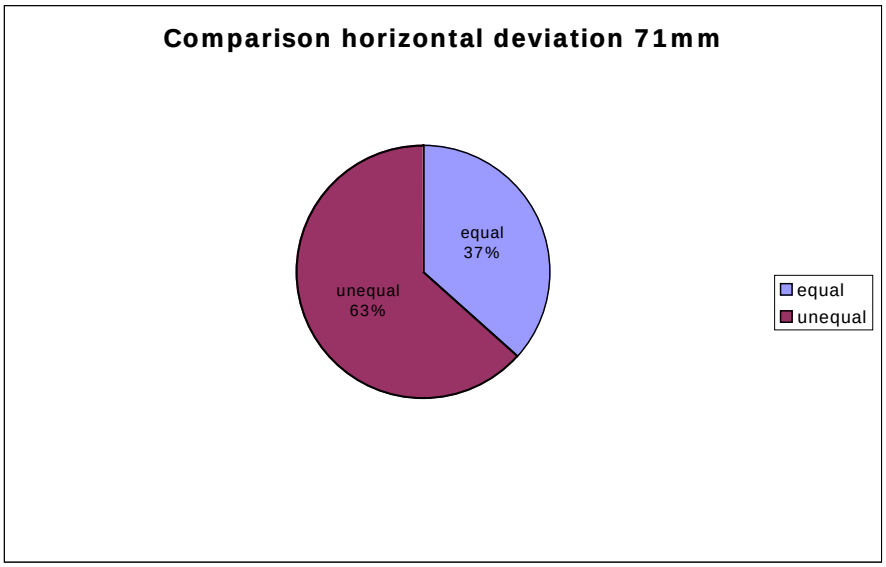
Statistical Evaluation of Results, ortholines at 70mm

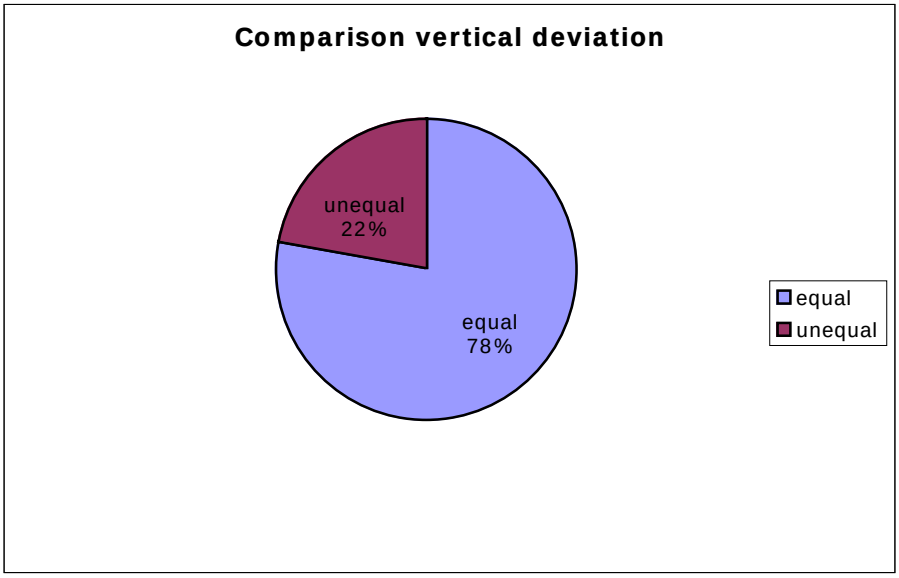
ortho=0 eso=1 exo=2

Patient No.	PD	Horizontal Polatest	Horizontal VOSd	Horizontal Polatest	Horizontal VOSd	equal
RW2130	65	exo	eso	2	1	
RW1060	64	eso	eso	1	1	1
RW2314	66.5	ortho	eso	0	1	
RW2209	60	exo	eso	2	1	
RW1988	63.5	eso	eso	1	1	1
RW1263	61	ortho	eso	0	1	
RW2656	54.5	exo	ortho	2	0	
RW1452	57	ortho	eso	0	1	
RW1329	60	exo	exo	2	2	1
RW2596	59	ortho	eso	0	1	
RW1951	65.5	ortho	eso	0	1	
RW1322	59.5	ortho	eso	0	1	
RW1324	57	eso	eso	1	1	1
MH1	62	exo	eso	2	1	
MH2	58	eso	eso	1	1	1
MH3	61	exo	ortho	2	0	
MH4	64.5	eso	exo	1	2	
MH5	65	ortho	eso	0	1	
MH6	54	ortho	eso	0	1	
MH7	67	exo	exo	2	2	1
MH8	60	ortho	eso	0	1	
MH9	56.5	eso	eso	1	1	1
MH10	62	ortho	eso	0	1	
MH11	64	exo	eso	2	1	
MH12	65	eso	eso	1	1	1
MH13	61	eso	eso	1	1	1
PP1	64	eso	eso	1	1	1
PP2	63	eso	eso	1	1	1
PP3	63.5	exo	ortho	2	0	
PP4	62.5	exo	ortho	2	0	
PP5	62.5	exo	exo	2	2	1
PP6	64.5	eso	eso	1	1	1
PP7	63.5	eso	eso	1	1	1
PP8	64	ortho	eso	0	1	
PP9	59.5	ortho	eso	0	1	
PP10	68	ortho	eso	0	1	
PP11	60	exo	eso	2	1	
PP12	67	exo	eso	2	1	
PP13	68	eso	eso	1	1	1
PP14	65.5	ortho	eso	0	1	
PP15	63.5	ortho	eso	0	1	

n= 41

Total			
	equal	15	36.585%
	unequal	26	63.415%


Comparison horizontal deviation 71mm
equal
37%
unequal
63%
equal
unequal

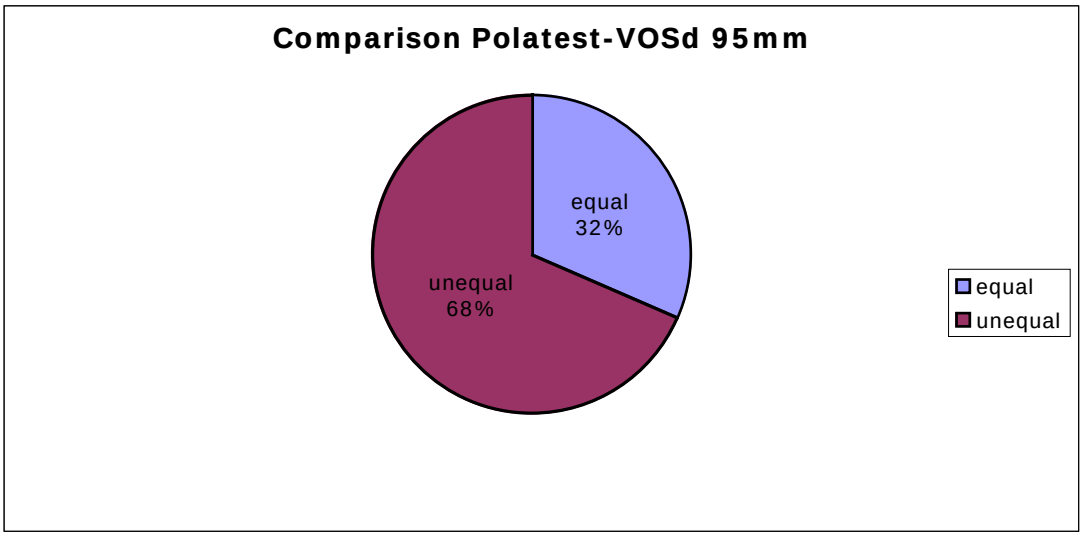

Comparison vertical deviation
unequal
22%
equal
78%
equal
unequal

Statistical Evaluation of Results, precise ortho-line at 95mm, no tolerance

ortho=0 eso=1 exo=2

Patient No.	PD	Horizontal Polatest	Horizontal VOSd	Horizontal Polatest	Horizontal VOSd	
RW2130	65	exo	eso	2	1	
RW1060	64	eso	eso	1	1	1
RW2314	66.5	ortho	eso	0	1	
RW2209	60	exo	eso	2	1	
RW1988	63.5	eso	eso	1	1	1
RW1263	61	ortho	eso	0	1	
RW2656	54.5	exo	eso	2	1	
RW1452	57	ortho	eso	0	1	
RW1329	60	exo	exo	2	1	
RW2596	59	ortho	eso	0	1	
RW1951	65.5	ortho	eso	0	1	
RW1322	59.5	ortho	eso	0	1	
RW1324	57	eso	eso	1	1	1
MH1	62	exo	eso	2	1	
MH2	58	eso	eso	1	1	1
MH3	61	exo	eso	2	1	
MH4	64.5	eso	exo	1	1	1
MH5	65	ortho	eso	0	1	
MH6	54	ortho	eso	0	1	
MH7	67	exo	exo	2	1	
MH8	60	ortho	eso	0	1	
MH9	56.5	eso	eso	1	1	1
MH10	62	ortho	eso	0	1	
MH11	64	exo	eso	2	1	
MH12	65	eso	eso	1	1	1
MH13	61	eso	eso	1	1	1
PP1	64	eso	eso	1	1	1
PP2	63	eso	eso	1	1	1
PP3	63.5	exo	eso	2	1	
PP4	62.5	exo	eso	2	1	
PP5	62.5	exo	eso	2	1	
PP6	64.5	eso	eso	1	1	1
PP7	63.5	eso	eso	1	1	1
PP8	64	ortho	eso	0	1	
PP9	59.5	ortho	eso	0	1	
PP10	68	ortho	eso	0	1	
PP11	60	exo	eso	2	1	
PP12	67	exo	eso	2	1	
PP13	68	eso	eso	1	1	1
PP14	65.5	ortho	eso	0	1	
PP15	63.5	ortho	eso	0	1	

n=	41	equal	13	31.707%
		unequal	28	68.293%



7. Statistics of research & significance of results

Chi-square test calculations

Since our study is comparing two methods of testing phorias and the sample of subjects being relatively small (n=41), we decided first to perform a non-parametric statistical evaluation. We separetely performed a chi-square-test for horizontal and vertical data collected which results as follow :

Horizontal

n	41

	Horizontal - VOSd			
Horizontal - Polatest	ortho	eso	exo	Total
ortho	0 (1.5)	15 (12.1)	0 (1.5)	15
eso	0 (1.3)	12 (10.5)	1 (1.3)	13
exo	4 (1.3)	6 (10.5)	3 (1.3)	13
Total	4	33	4	41

X^2 statistic	15.34
p	0.0040

Vertical

n	41

	Vertical OD - VOSd			
Vertical OD - Polatest	ortho	hyper	hypo	Total
ortho	26 (22.7)	3 (4.4)	1 (2.9)	30
hyper	1 (3.0)	3 (0.6)	0 (0.4)	4
hypo	4 (5.3)	0 (1.0)	3 (0.7)	7
Total	31	6	4	41

X² statistic	23.10
p	0.0001

We could find a low p-value which indicates significance in the results of the two tests performed. The results of the vertical deviations are markedly more precise than the results in horizontal deviations. Since the chi-square test compares the similarity in the number of each kind of phorias, it does not tell us the correlation for each particular individual. Therefore we decided to calculate in addition the standard error with a confidence interval of 95%, which appears more relevant to us.

Standard error calculation of horizontal deviation; ortholines at 71mm:
Our sample consists of 41 patients.
Among these 41 people, the phorias direction has been identical between both tests for 15 patients (36.5853%)

The standard error equals :

$$\sigma_p = \sqrt{\frac{p(100-p)}{n-1}}$$

p is the percentage calculated on 41 patients which the phorias direction is identical.
n is the amount of patients : 41

$$\sigma_p = \sqrt{\frac{60.9756(100-60.9756)}{41-1}} = 7.7129$$

If we choose a confidence interval of 95%, Z-value is considered 1.96

The confidence interval of the true percentage extrapolated for an infinite population is done by formula:

$$p - Z\sigma_p < \pi < p + Z\sigma_p$$

$36.5853 - 1.96 \times 7.6158 < \pi < 36.5853 + 1.96 \times 7.6158$

$21.6582 < \pi < 51.5124$

This means that according on our studies based on a sample of 41 patients, the results according to Collier's method extrapolated to an infinite population will give following datas.
The VOS drawings will be equal to Polatest in 51.5124% of cases with the most optimistic evaluation. In this case, it means that 1 patient over 2 will be judged wrong. He could either be considered by phoric and being treated for a defect he doesn't have (false positive), or falsely thought as orthophoric (false negative).
In the most pessimistic statistical calculation, VOS drawings will only be equal to Polatest in 21.6582 %. In this case, more than three over four patients would be evaluated wrongly.

Standard error calculation of vertical deviation:
The standard error equals :

$$\sigma_p = \sqrt{\frac{p(100-p)}{n-1}}$$

p is the percentage calculated of the 41 patients by which the phorias direction is identical.
n is the amount of patients : 41

$$\sigma_p = \sqrt{\frac{75.6098(100-75.6098)}{41-1}} = 6.79$$

With the same confidence interval of 95%, we get :

$$p - Z\sigma_p < \pi < p + Z\sigma_p$$

$75.6098 - 1.96 \times 6.79 < \pi < 75.6098 + 1.96 \times 6.79$

$62.3001 < \pi < 88.9181$

Refering to the vertical phorias, the VOSd would be in concordance with the Polatest in 62.3% of the cases at the worst, in 88.9% at the best. These results permit us to assume that VOSd is really more reliable concerning the detection of vertical deviation. This can actually be easily explained by the absence of near-feeling convergence bias acting on the vertical deviations.

Standard error calculation of horizontal deviations; ortholines at 95mm:

The standard error equals :

$$\sigma_p = \sqrt{\frac{p(100-p)}{n-1}}$$

$$\sigma_p = \sqrt{\frac{31.7073(100-31.7073)}{41-1}} = 7.3557$$

The confidence interval is still 95%, Z-value is considered 1.96 :

$$p - Z\sigma_p < \pi < p + Z\sigma_p$$

$$31.7073 - 1.96 \times 7.3557 < \pi < 31.7073 + 1.96 \times 7.3557$$

$$17.7073 < \pi < 46.1228$$

We can notice here that according to the purely optical concept, the reliabilty of the VOSd decrease still more. At the best VOSd wil correlate with Polatest in 46.1%, it is said less than one over two patients. And if we look closer to the results, can notice that all patients have been reported as esophoric. This would confirm the hypothesis of an interference of a near-feeling convergence. The patient behind the biopter cannot relax properly his convergence. Furthermore, this near feeling may probably be exacerbated by the fact that the VOS drawing is an active method. The patient carry out a task he is used to do at near so that his convergence get involuntarily stimulated. We can still add to this that the centripetal drawing of the VOS fan could eventually be one more explanation of this shift towards esophoria.

8. Discussion and conclusion

According to the above mentioned results we had to reject our Hypothesis. VOSd can therefore not be used as a screening method to reliably detect phorias.

Nevertheless VOSd might be helpful to the experienced practitioner to gain more informations about the patient’s visual behavior. We do have to stress the inconsistency in expected results, though. Therefore our emphasis is that one should not overestimate the results of the VOSd in respect of phorias detection and training. It would be a misconcept to treat a phoria detected only by a VOSd.

By executing the test we noticed different influences that could interfere with the results.

First, it is essential to know the optics of the stereoscope in use since not all stereoscopes on the marked have the same optic-center-separation. In addition to this the exact position of the ortholines is discussed controversial as mentioned before.
About this point, we have to reject the idea to shift ortholines nasally from the optic axis of the lenses to get some similarity with Polatest results. Only this fact indicates that this method cannot be validated as phorias screening at far and that interferences stimulate the convergence. As mentioned before, these biases are the near-feeling due to this kind of devices, the mental association to a task usually done at near and the drawing itself directed towards the center of the sheet. We actually

tried to evaluate the sheets with the so-called “ortholines” at 62mm. We got then more comparable results between Polatest and VOSd and quite the same amounts of eso, exo and orthophorias. However, this would correspond to a 15 prisms convergence what is the convergence needed at 40 cm with a 61mm PD. This attests that the VOSd is not appropriate to detect far deviations.

Second, it is not possible for the optometrist to control the patient’s fixation. If a patient concentrates on one of the pencils instead of the centre of the paper the result will be altered.

Third, the evaluation of the drawing is often subject to the optometrist’s perception rather than measurement. Not all drawings exhibit a regular fan-shaped star-pattern. Differences in the results of several millimetres are to be expected.

We therefore conclude that the Polatest is the instrument of choice to detect phorias. Nevertheless we don’t deny that the VOSd may be of value evaluating a patient’s visual behavior as mentioned before.

Further studies may in the future assesses the advantages of the VOS drawings in the follow-up of visual training patients. As it seems empirically obvious that individuals get more regular VOS patterns after exercices, some investigations this area what would then make it more scientifically more valid.

9. Appendix

Appendix I : VOSd Instruction-sheet to the patient

Direct the patient to please sit in front of the instrument and look through the eyepiece. Ask him: "How many columns of figures do you see?" If the answer is two, ask, "Can you see both columns at the same time, or do they appear one at a time?" If the answer is two, again, direct the patient to take two same-size pencils, one in each hand.

Guide the patient to hold the pencils so as to write with them simultaneously. The patient’s hands and elbows should be free of the instrument and the table. Ask him to place a pencil point on the centre cross of each column - right pencil on the right cross, left on the left. Now ask, "Can you see both pencil points at the same time?"

If yes, instruct the patient to constantly fixate the centre of the sheet halfway between the columns at the side of the chart, and to "look through the fog". Have him draw simultaneous lines, one toward the other, until the pencil points look (and not feel) as if they're touching. Next, place the left pencil on the top figure of the left column, and the right pencil on the bottom figure of the right. As before, the two pencils are to be brought toward each other until they appear to touch. The procedure is repeated with successive figures until the star pattern is complete.

Appendix II :Polatest instruction-sheet to the patient

Pupillendistanz in mm/*Eye distance:*

Kreuztest/ Cross-Test

Am Kreuz zuerst nur mit dem rechten danach nur mit dem linken Auge zeigen. Fragen was der Kunde jeweils erkennen kann. Danach den ganzen Test zeigen und vergewissern, dass er alle Testteile simultan sieht. Nach der Zentrierung fragen. Notieren mit Pfeil, in welche Richtung die Abweichung vom rechten Auge aus gesehen wird.
First show the cross just with the right eye and then just with the left eye asking the patient what he is recognizing. Afterwards show the complete test and make sure that he sees it simultaneously. Ask for centring.
Mark with an arrow the direction of the phoria seen from the right eye.

Zeigertest/Pointer-Test

Test wie beim Kreuz erklären. Kunde nicht auf zentralen Kreis fixieren lassen. Die Lage der Zeigerenden in Relation zur Skala beurteilen lassen. Verschiebung wieder durch Pfeil notieren.
Explain the Pointer-Test the same way as the Cross-Test. Evaluate the position of pointers in relation to the scale. Patient should not fixate the middle circle. Note the deviation with an arrow seen from the right eye.

Hakentest/Bracket-Test

Test wiederum wie bei den Beiden vorangegangen erklären. Kunde auf den zentralen Kreis fixieren lassen. Fragen ob eine Seite des Quadrates nach oben oder unten abweicht. Mit Pfeil Abweichung notieren; vom rechten Auge aus gesehen.
Explain the Bracket –Test as the both above. Patient should fixate the centre circle. Ask for deviation of the right hand side of the hal- square (up or down) Note with an arrow on which side the deviation is, seen from the right eye.

10. Bibliography

(1) Van Orden, Millard E., "Keystone Manual of Rehabilitation Techniques", Keystone View Co., Meadville , Penn. (No date of publication given), pg. 1-9

(2) Lesser, S.K., "Questions and Answers", Vol. 2, No. 2, Optometric Extension Program, Duncan, Oklahoma, 1952, pg. 3-4

(3) Mac Donald, L.W., "A programmed approach to visual training", Visual training, Series 1, No. 2 and No. 5, Optometric Extension Program, Duncan, Oklahoma, 1962 – 1963, pg. 9&27

(4) Kaplan, Melvin, O.D., "The Van Orden Star: A Window Into Personal Space", www.authisticvision.com, 2004, pg. 4

(5) OEP, Optometric Extension Program, Author unknown, "The Van Orden Star", Series 2, No. 6, 1967, pg. 36

(6) Keystone View Company, Instruction Manual to the Van Orden Technique of Visual Rehabilitation

(7) OEP, Optometric Extension Program, Judy Myers, B.A. COVTT, 1997, Vol. 38, pg. 53-57

(8) Binoculare Korrection, Methodic und Theorie von H.-J. Haase, 1980, Verlag Willy Schrickel, Düsseldorf, p. 131-144

(9) Zur Fixation disparation, Hans-Joachim Haase, Verlag Optische Fachveröffentlichung Gmbh, Heidelberg, p 222-232

(10) Collier Stefan, Optometrist, Visual-Training courses, 2001, Solothurn, Switzerland

(11) Dr. Sheare, The Bernell Corporation, USA, 2004

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