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Diagnostic Occlusion and Clinical Management of Latent Hyperphoria

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ABSTRACT

Occasionally in patients who have symptoms suggestive of a vertical heterophoria no deviation is found, even on careful examination. Six days of occlusion have been recommended for uncovering such "latent" vertical deviations. We investigated prolonged monocular occlusion (Part I) and found that vertical deviations of varying amounts manifested on symptomatic and asymptomatic subjects. Thus, results of prolonged occlusion can be difficult to interpret. Nonadaptive vertical vergence systems have been implicated in development of symptoms. Therefore, it may be that diagnostic monocular occlusion is not appropriate unless patients have symptoms of vertical imbalance. We used (24 h) occlusion and associated phoria measurements (Part II) to determine vertical prism prescriptions which eliminated symptoms of seven symptomatic patients who did not show significant vertical heterophoria on routine clinical testing. We present data and case reports which elucidate the efficacy of this procedure.

Key Words: latent hyperphoria, occlusion, associated phoria

nitude obtained in the measurement of a hyperphoria even after up to 2 h of monocular occlusion.³ Roy² suggested a prolonged (6-day) occlusion technique which he implied would elicit the full amount of a latent hyperphoria.

Recently fixation disparity techniques have been advocated for assessment of vertical deviations. For patients who manifest a vertical deviation, the amount of prism to be prescribed can be determined directly by associated phoria measurements.⁴ However, a vertical fixation disparity must be manifest before this technique becomes useful. Current clinical care standards lack a definitive method for prescribing prism for symptomatic patients who do not manifest a vertical heterophoria but who have a latent hyperphoria. The lack of a practical method for prescribing vertical prism in cases of latent hyperphoria often causes practitioners to resort to a trial-and-error method or abandon the task completely. The purpose of this study is to evaluate a method for diagnosis of latent vertical phoria and to describe a clinically useful technique which can be used to prescribe prism for the symptomatic patient with a latent hyperphoria.

PART I

vertical deviations: e.g., losing place when reading and skipping lines when reading (Appendix 1).

The best lens correction for each subject was determined by retinoscopy and maximum plus refraction. The criteria used for subject selection are included in Table 1.

Test Procedure

Subjects were divided into symptomatic and asymptomatic groups based on their answers to 10 multiple choice questions (Appendix 1). Each question had five possible answers that were assigned a point value inversely related to the severity of the symptom. The sum of the points assigned to all answers determined the subject's group; those in the symptomatic group scored lower than 20 points. The habitual distance correction was worn during all experimental procedures. Each subject com-

(dissociated and associated phorias) were reassessed as described above.

RESULTS

In Part I most subjects manifested a postocclusion vertical deviation. Symptomatic subjects showed a slightly larger postocclusion associated vertical deviation than asymptomatic subjects (Table 2). The opposite was found for dissociated measures. Using the two sample t-test for each variable, we found that the difference in postocclusion vertical deviation between symptomatic and asymptomatic groups was not statistically significant. The difference in standard deviation between symptomatic and asymptomatic groups was not significant for dissociated measures ($p = 0.2235$) but was statistically significant for associated measurements ($p = 0.0004$).

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suggest that the test could be useful under the right circumstances. Perhaps patients who have symptoms of a vertical deviation, yet do not manifest a deviation on conventional testing and who have all other findings essentially normal, could benefit from a trial period of monocular occlusion and subsequent prescription of vertical prism. If this view is correct, it is not the magnitude of the vertical heterophoria that is uncovered by occlusion but the fact that it is associated with symptoms that is important.

PART II

The symptoms of vertical heterophoria are varied⁹ and may be similar to symptoms of other types of binocular dysfunction. Therefore, before suspecting a latent vertical deviation, a thorough examination of the lateral vergence and accommodative systems should be carried out. When no binocular anomaly is found on conventional testing and symptoms are still present even after correction of refractive error, diagnostic monocular occlusion could be useful for determining a management strategy for the symptomatic patient who might otherwise be told "nothing is wrong with your eyes."

When vertical prism is placed before one eye of an isophoric patient, remeasurement of the induced vertical deviation after 15 min will indicate that the resultant deviation is less than the amount of prism placed before the eye. This adaptation to vertical prism has been shown by Eskridge¹⁰ and others,^{11,12} and individual differences in the rate and amount of prism adaptation have been observed.¹³ Nearly 80% of patients adapt to vertical prism.¹² However, symptoms generally are not reported by patients who completely adapt to vertical prism.¹¹ This suggests that patients who have reduced ability to adapt to prism are those who manifest symptoms.

In Part II we investigate whether prescription of vertical prism corrections which neutralize the associated phoria present after prolonged occlusion will reduce or eliminate the symptoms of patients who initially have no obvious binocular anomalies.

Patients

Seven patients from the binocular anomalies clinic at University of Houston College of Optometry (UHCO) had long-standing symptoms (which were apparently related to a vertical imbalance), even after many spectacle or contact lens prescriptions. One had worn a small vertical prism correction previously without symptomatic relief (see Case Report 2). They apparently had normal binocularity with little or no vertical deviation evident on conventional testing. All had comitant horizontal phorias.

METHODS

Prescription Determination

Patient symptoms were assessed in the case history. The best lens correction for each patient was

determined by retinoscopy and maximum plus refraction. Prism corrections were determined by clinical judgment based on associated phoria, severity of symptoms, and monocular occlusion. Monocular occlusion was used to determine the vertical correction by first determining from the fixation disparity curves and dissociated phoria measurements which eye had a tendency to be hyperphoric and occluding that eye for 24 h.

When the patient returned the next day (still occluded), dissociated phoria measurements were taken at distance and near immediately after removal of the patch and without allowing fusion to occur. Vertical fixation disparity measurements were taken using the prism amount determined by the dissociated phoria measurements as the starting prism. Thus, prism prescriptions were determined from the prism required to reduce the associated phoria to zero after 24 h of occlusion.

Vertical vergence ranges were invariably symmetrical and, thus, did not influence the decisions concerning the vertical prism correction for these patients with latent vertical deviations. These patients all had refractive errors in the two eyes that were so nearly equal that lens prescriptions were made using equal (stock) base curves and equal center thicknesses.

Evaluation of Prescription

A progress examination was scheduled after the patient had worn the spectacles with the vertical prism prescription for 1 to 3 weeks. Symptoms were re-evaluated with case history and vertical associated phorias were measured through the spectacles.

Because reduced binocular function might impair visual performance, patients were given a standardized visual efficiency test twice (in random order), once while they wore the prism correction for the vertical deviation and once without prism correction. Before collecting the efficiency data, each patient completed one visual efficiency test to minimize practice effects. We hypothesized that patients wearing a prism prescription that improved binocularity would have improved performance on the visual efficiency test.

RESULTS

In Part II six of seven subjects showed improved performance on the visual efficiency test with their

TABLE 3. Visual efficiency performance, vertical correction vs. zero prism (with best refractive correction).

Subject No.	Lines Completed Without Prism	Lines Completed With Prism	Difference
1	136	148	+12
2	132	167	+35
3	93	115	+22
4	123	156	+33
5	123	123	0
6	76	91	+15
7	79	93	+14

vertical prism prescription in place (see Table 3). Using the sine test, the difference in number of lines completed was statistically significant ($p = 0.0313$). This result was corroborated by the t-test. All subjects reported greater ease in completing the visual efficiency examination. More significantly, all had a significant decrease or total alleviation of previous symptoms while wearing vertical prism (Table 4).

PART III. ILLUSTRATIVE CASE REPORTS

Case 1 (Patient 4)

A 13-year-old male had difficulty reading. He complained of slow reading, loss of place while reading, reading the same line when going back to the beginning of a line, headaches after approximately 30 min of reading (eyelid/brow area), and blurring of material after the onset of headaches. He stated that blinking cleared the near blur.

The current spectacle prescription was:

OD -4.00 DS

OS -3.75 DS

Refractive error was:

OD -3.75 DS 6/4.5 (20/15)

OS -3.50 DS 6/4.5 (20/15)

All further testing was performed through the habitual spectacle lenses. Cover test and Maddox Rod testing revealed 1^Δ of exophoria in all fields of gaze at distance and near. The associated phoria findings were orthophoria/isophoria at distance and an unstable 0.75^Δ left hyper associated phoria at near which increased with time. There were no changes in associated phoria response as the patient shifted vision into lateral gaze. The accommodative status was examined with Monocular Estimate Method (MEM) retinoscopy:

OD +0.75 D

OS +0.50 D

and binocular accommodative facility: 6 cycles/60 s using +2/-2 D at near.

TABLE 4. Number of subjective complaints before and after vertical prism correction.

Symptom	Number Before Prism	Number After Prism
Loses place when reading	4	1
Skips lines/reads same line	3	
Eyes tire easily	3	
Slow reading	3	
Eye "strain"	2	1
Headaches	2	
Burning sensation	2	
Blurring of reading material	1	

Vergence facilities were:

14^Δ BO/8^Δ BI at distance: 3 cycles/30 s

14^Δ BO/12^Δ BI at near: 3 cycles/30 s

Vergence ranges in prism diopters were:

Distance BI ×/9/6 BO ×/17/6

Near BI 11/23/18 BO 10/20/18

Vertical vergence ranges were symmetrical at distance and near. Based on the examination findings, the habitual spectacle correction was judged to be adequate, as were accommodative and fusional abilities. Instability and variability of the vertical associated phoria measurement suggested a latent left hyperphoria and it was decided that diagnostic occlusion would be useful for further assessment. The patient was instructed to patch the left eye constantly 24 h before a follow-up examination. During the follow-up examination the patch was removed and fusion was prevented until associated phoria measurements were taken. Cover test at distance revealed 2^Δ left hyperphoria. Associated phoria testing at distance revealed 2.75^Δ left hyperphoria.

The myopic correction alone and then with the addition of 2.75^Δ base-down before the left eye was placed into a trial frame and the patient was allowed to read for 10 to 15 min under both conditions. He preferred to read with the additional 2.75^Δ base-down. He expressed a feeling of less eyestrain and more accurate eye movements (easier returning to the next line of letters). The following spectacle prescription was given for full-time wear:

OD -3.75 D

OS -3.50 D 2.75^Δ DOWN

With the new prescription, the patient initially experienced mild discomfort which subsided in less than 30 min. At this visit and for at least 1 year (the latest follow-up) he reported a decrease in the frequency of losing his place while reading, and has experienced no symptoms while reading. Associated phoria measurements continued to indicate that approximately 3^Δ base-down was required before the left eye to reduce the left hyper fixation disparity to zero. All other findings were within normal limits.

Case 2 (Patient 6)

A 41-year-old female reported uncomfortable near work, especially when tired. She complained of not being able to read for more than 10 min before symptoms became so severe that she was forced to abandon her task. In addition, she used a guide while reading because she frequently lost her place. She had been seen 4 years previously with the same complaints of eyes tiring easily, words running together, burning, and itching after near work. At that time her condition was diagnosed as convergence insufficiency with left hyperphoria.

The spectacle correction, given for her moderate astigmatism, included 1.5^Δ base-in before the right eye and 1^Δ base-up before the left. She was also started on convergence therapy. Now she was seeking care for the same severe reading symptoms.

Examination revealed a refractive error of:

OD -0.25 -1.50 × 175 6/6 (20/20)

OS -0.50 -0.25 × 175 6/6 (20/20)

The cover test showed 2^Δ exophoria with 0.5^Δ left hyperphoria at distance and 13^Δ exophoria at near. Although there is potentially an anisophoria induced by the 1.00 D difference in the refractive correction of the two eyes, the heterophoria did not vary in any position of gaze as measured by Maddox rod testing. The nearpoint of convergence was to the nose. Base-out ranges in prism diopters were ×/18/3 at distance and ×/6/-12 at near. Upon vertical associated phoria testing an isophoria response was given. Vertical vergence ranges were variable but asymmetric with right infra vergence slightly larger (see Discussion). New spectacles were not prescribed, although convergence therapy with Brock string was initiated. At subsequent progress examinations more aggressive training was prescribed in the form of an eccentric ring/lens flipper combination. Base-out vergence ranges continued to improve over a 2-month period, but symptoms remained in variable degrees of severity. The patient was occluded monocularly for approximately 15 min with no increase in associated vertical phoria when the patch was removed. Convergence therapy was continued.

The patient finally reached the point where her current spectacles could not be worn comfortably at near. A +1.00 D add was prescribed and the convergence training was discontinued. The add improved near visual acuity, but the symptoms of eyes tiring and losing her place while reading remained. Associated phoria measurements over the new glasses now showed a need for 2^Δ base-up over the right eye. This was prescribed along with a resumption of convergence therapy.

Convergence therapy continued over the next several months and the cover test and vertical associated phoria measurements revealed a gradual increase in the vertical deviation to 6.25^Δ left hyperphoria. The AO Space Eikonometer showed no significant image size difference that would contribute to her symptoms. Additional prism was given in the spectacle prescription:

OD +0.25 -1.50 × 175 3^Δ UP

OS -0.25 D 3.25^Δ DOWN

+1.00 FT 28 Add

Base Curve - 6.50 OD, OS

Center Thickness - 2.8 mm

Reading for periods up to 1 h was much more comfortable with the new spectacles. She no longer

required a guide when reading but she occasionally noticed vertical diplopia at distance, especially at night when tired. Using the red/green TV trainer she experienced intermittent suppression. The TV trainer was dispensed along with horizontal and vertical vergence therapy. The patient still complained of occasional distance diplopia. Intermittent suppression at distance was also present during progress examinations. With 6^Δ base-down before the left eye associated phoria measurements at near continued to show an isophoria response.

Repeated testing indicated that 4^Δ base-down before the left eye was sufficient to allow clear comfortable distance vision without diplopia. Based on these differences in prism required for distance and near viewing, it was decided to decrease the vertical prism in the spectacles by 2.25^Δ. As expected, this brought back near symptoms while concurrently alleviating distance diplopia and suppression. Associated phoria testing again showed the need for more vertical prism at near.

A slab-off correction was rejected by the patient due to cost. Therefore, two pairs of spectacles were prescribed.

For distance:

OD +0.25 -1.50 × 175 3^Δ UP 4 Δ total

OS -0.25 -0.25 × 180 1^Δ DOWN

+1.00 add FT 28

Base Curve - 6.50 OD, OS

Center Thickness -2.8 mm

For near:

OD +1.00 -1.50 × 175 3^Δ UP 6 Δ total

OS +0.75 -0.50 × 180 3^Δ DOWN

Base Curve - 6.50 OD, OS

Center Thickness - 3.0 mm

Home vision therapy was continued. The new spectacles provided clear, single, and comfortable vision for distance and near. Diplopia was not noticed at distance and reading was comfortable for up to 3.5 h without the use of a guide. The latest bifocal prescription (4^Δ total vertical correction) continued to provide adequate distance vision with occasional blur and considerable eye fatigue at near. Results of the final progress visit were:

With distance prescription:

cover test - no movement seen

associated phoria - isophoria response

vergence ranges BI ×/10/4

BO 16/30/12

With near prescription:

- cover test - 8^Δ exophoria
- associated phoria - isophoria response
- vergence ranges BI ×/20/18
BO ×/25/8

The patient was instructed to continue horizontal and vertical vergence therapy by performing prism jump repetitions with suppression checks. She was asked to return for progress examination in 6 months, or if symptoms returned.

At the 6-month visit she stated that she had discontinued the vision therapy with a subsequent return of mild symptoms which were alleviated soon after resuming the therapy. Maintenance therapy was prescribed each day for 1 month, then twice weekly until her next complete yearly examination.

DISCUSSION

Vertical prism adaptation occurs in asymptomatic patients¹¹ with normal binocularity.¹⁴ Schor¹⁵ has suggested that patients who do not adapt adequately to vertical prism are most likely to be symptomatic. A case report presented by Bergin et al.⁵ illustrated that a substantial vertical phoria can exist and only become manifest after prolonged occlusion (Fig. 1). The patient in their case study was symptomatic and expressed a "dislike for reading."

Lie and Opheim¹⁶ used prism to correct heterophoric patients with long-standing severe visual symptoms. They reported that a small vertical deviation was present in most of these patients. Furthermore, in 80% of these patients prism corrections needed to be increased over a period of time before the full deviation was determined. As illustrated by one of the case reports above, some patients may require multiple prism corrections before the deviation is completely compensated (Fig. 2).

Aniseikonia and anisophoria¹⁷ might be suspected to influence our results. However, except for two of our patients, the refractive errors were either equal or had a maximum of 0.25 D difference between the two eyes. Although aniseikonia can occur in isoametropia,^{18,19} the equal refractive errors

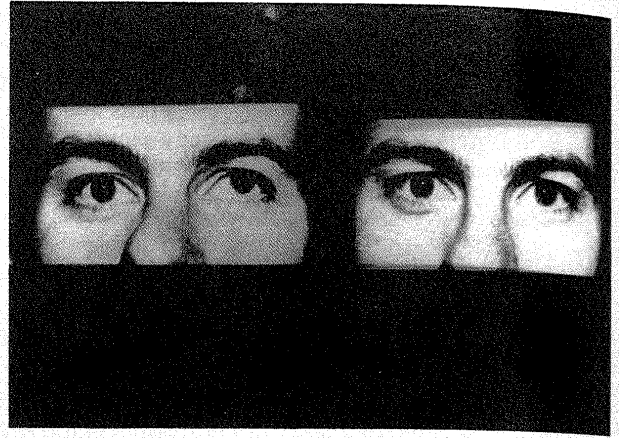


Figure 1. This patient had a hyperphoria of more than 50^Δ that only became manifest after prolonged occlusion (Adapted from Bergin et al.⁵)

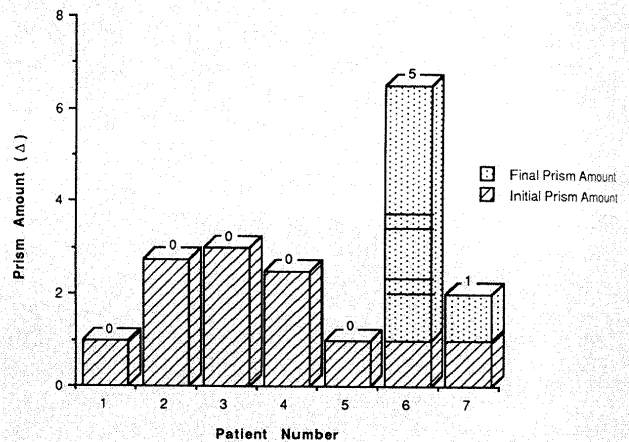


Figure 2. The results of prism prescriptions for our seven patients with latent hyperphoria indicate that two required an increase in prism prescription before the amount of prism that eliminated symptoms was reached. Only Patient 6 required multiple (five) changes—see text, Case 2. For the two patients requiring an increase in prism correction, the lines on the bars indicate the amount of prism prescribed at each visit.

make aniseikonia an unlikely cause of the symptoms experienced by our patients, especially because vertical prism corrections eliminated their symptoms. Two patients had 0.75 D refractive difference in one or both meridians. Patient 2 had 0.75 D horizontal difference and 0.00 D vertical

TABLE 5. Clinical management of vertical heterophoria.

Vertical	Symptoms	Diagnostic Occlusion	Treatment	Estimated % of Patients
None present	None	No	None	80
Phoria or fixation disparity	None	No	Usually none, consider if avoiding tasks	3
Phoria and fixation disparity	Yes	No	Prescribe prism based on vertical fixation disparity	12
Fixation disparity only	Yes	No	Prescribe prism based on vertical fixation disparity	3
None on routine testing	Yes	Yes (1 day over the eye that tends to have the hyper)	Prescribe prism based on vertical fixation disparity seen after diagnostic occlusion	2

difference, whereas Patient 6/Case 2 had 0.75 D horizontal and vertical difference. Although these refractive differences could cause significant anisophoria and/or aniseikonia,¹⁷ measurements of heterophoria with Maddox rod and cover testing in all fields of gaze indicated no significant anisophoria for either patient. Furthermore, no changes in alignment of the vernier lines used in fixation disparity testing were noted as targets were moved laterally and vertically, also suggesting no significant anisophoria. Aniseikonia testing was done on Patient 6/Case 2 using the Space Eikonometer and only 0.25% difference was found between the retinal image size of the two eyes. These factors, plus the alleviation of symptoms with vertical prism, indicate that neither aniseikonia nor anisophoria were factors in our results.

Our current study confirms that small latent vertical phorias can cause patients to be symptomatic. And, just as with some deviations of larger amounts, these vertical deviations only become manifest with prolonged occlusion. After using prolonged occlusion to elicit the latent vertical deviation, the method of choice for determining the amount of prism is associated phoria testing.⁴ Vertical vergence ranges are less useful in determining an appropriate prism amount due to the variability of measurement which depends on factors such as the speed at which the prism disparity is introduced,¹ the distance at which the measurement is taken,²⁰ and the actual vertical deviation.²¹

When corrected with prism our patients experienced a decrease or total alleviation of symptoms. It is unlikely that such prism acts only as a placebo because all these patients had undergone numerous examinations and worn spectacle corrections previously, without symptomatic relief. Our patients reported an immediate decrease in severity of symptoms after the initial prism correction. However, symptoms returned if more prism was required to fully correct the deviation. It is apparent that prism correction is not merely treatment of symptoms, but treatment of the problem which causes symptoms.

Clinical Application

Estimates of the incidence of vertical deviations range from 7%²² to 52%.²³ Because of the wide range reported in the literature, it is difficult to be certain of the exact incidence but, based on an average of the results reported in studies over the last 100 years,⁹ a reasonable estimate of the incidence of vertical deviations in a clinical population is approximately 20%. In our estimation about 10% of these have the type of latent vertical heterophoria described in Part II of this paper (i.e., around 2% of the total clinical population, or approximately the same number often considered to have glaucoma²⁴).

Management of the patient with a vertical heterophoria is complicated by the fact that different combinations of symptoms and heterophorias oc-

cur, as illustrated in Table 5. When a hyperphoric patient is truly asymptomatic, management is generally deferred (Table 5, row 2). However, clinicians should consider that the patient may be asymptomatic because of avoidance of tasks which cause symptoms, rather than being truly asymptomatic; in this instance treatment may be indicated. Patients who have symptoms and who manifest a vertical heterophoria or a vertical fixation disparity are easily managed (Table 5, rows 3 and 4) by prescribing prism based on fixation disparity testing, with vertical vergence training, or a combination of these procedures.

The most difficult management decisions arise when the patient has symptoms suggestive of a vertical deviation (Table 4) but no vertical heterophoria is evident on routine clinical testing. In this paper we present a well defined standard of clinical care for patients with latent hyperphoria. Based on our findings the patient with latent hyperphoria can be managed successfully following the procedures listed in Table 5, row 5.

When symptoms suggest a vertical heterophoria but clinical examination fails to uncover one, 24 h of diagnostic occlusion of the eye that is suspected to have the hyperphoria is indicated. The occasionally difficult decision concerning which is the hyperphoric eye is based on cover testing (including patient reports of phi phenomena movement), vertical fixation disparity curves, and reports of vertical instability of the horizontal nonius lines on fixation disparity testing. After occlusion, vertical prism that neutralizes the vertical fixation disparity (associated phoria) can be prescribed and vertical vergence therapy might be considered. The guidelines presented in Table 5 provide a clinically useful treatment sequence which eliminates symptoms for most patients having (manifest or latent) hyperphorias.

If symptoms return, and there is an increase in the associated hyperphoria, an increase in the vertical prism prescription may be considered. Usually re-evaluation in 1 month and again in 6 months will be sufficient to determine the need for any required change in prism correction. We have found that an occasional need for an increase in prism seems to be a feature of the latency of the deviation; about 40% of patients with latent hyperphoria require small increases in prism to maintain comfortable binocular vision in much the same manner that patients with latent hyperopia require increases in plus power as latent hyperopia becomes manifest. The increase in prism does not seem to be related to prism adaptation in the classic sense. Usually only one or maybe two small (0.5 to 1.0⁻²) increases in prism are required to again alleviate symptoms. If adaptation to the prism were occurring then it would be expected that there would be continued larger increases as the patient wore and adapted to the prism correction.

CONCLUSION

Based on the results of Part I, prolonged monocular occlusion is not appropriate as a diagnostic test of vertical heterophoria for patients without symptoms or those who have symptoms that do not suggest a vertical deviation. However, patients who have symptoms of a vertical deviation, in whom no vertical heterophoria can be found with conventional testing procedures, can be evaluated with prolonged occlusion. If a vertical deviation is found, prism can be prescribed to alleviate symptoms. All subjects participating in Part II reported greater ease in completing the visual efficiency examination and had a decrease or total alleviation of previous symptoms after vertical prism was incorporated in a spectacle prescription.

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APPENDIX 1

To assess symptoms each subject answered the questions below. Each answer was assigned the point value listed next to the answer and the sum of the results for all of the questions determined the total score. In this study subjects with a total score of less than 20 were considered symptomatic.

1) How long can you do "nearwork" (i.e., reading, writing, sewing, etc.) with no discomfort (e.g., headaches, eye ache, burning, stinging, watering, blurriness, double vision, loss of concentration, tiredness, or falling asleep)?

- 1) up to 15 min
- 2) up to 30 min
- 3) up to 1 h
- 4) up to 2 h
- 5) at least 3 h

2) How often do you get headaches when you do nearwork?

- 1) every time (100% of the time)
- 2) very often (75% of the time)
- 3) often (about 50% of the time)
- 4) occasionally (about 25% of the time)
- 5) never (0% of the time)

3) If you experience headaches during nearwork, how bothersome are these headaches (i.e., the degree to which they interfere with your normal functioning)?

- 1) extremely bothersome
- 2) very bothersome
- 3) moderately bothersome

4) mildly bothersome

5) minimally bothersome

4) Do your eyes pull, ache, or water when you do nearwork?

- 1) every time I read (100% of the time)
- 2) very often (about 75% of the time)
- 3) often (about 50% of the time)
- 4) occasionally (about 25% of the time)
- 5) never (0% of the time)

5) Does the reading material ever become blurry, run together, or jump when you do nearwork?

- 1) every time (100% of the time)
- 2) very often (about 75% of the time)
- 3) often (about 50% of the time)
- 4) occasionally (about 25% of the time)
- 5) never (0% of the time)

6) Do you ever skip words or lose your place in the middle of a line while reading?

- 1) every time (100% of the time)
- 2) very often (about 75% of the time)
- 3) often (about 50% of the time)
- 4) occasionally (about 25% of the time)
- 5) never (0% of the time)

7) Do you ever read the same line twice while reading (when going back to the beginning of the next line you find yourself on the line just read)?

- 1) every time I read (100% of the time)
- 2) very often (about 75% of the time)
- 3) often (about 50% of the time)
- 4) occasionally (about 25% of the time)
- 5) never (0% of the time)

8) Do you ever skip a line while reading (when going back to the beginning of the next line)?

- 1) every time I read (100% of the time)
- 2) very often (about 75% of the time)
- 3) often (about 50% of the time)
- 4) occasionally (about 25% of the time)
- 5) never (0% of the time)

9) Does the reading material ever become double when you do nearwork?

- 1) every time (100% of the time)
- 2) very often (about 75% of the time)
- 3) often (about 50% of the time)
- 4) occasionally (about 25% of the time)
- 5) never (0% of the time)

10) Do your eyes feel tired and/or do you lose your concentration when you do nearwork?

- 1) every time (100% of the time)
- 2) very often (about 75% of the time)
- 3) often (about 50% of the time)
- 4) occasionally (about 25% of the time)
- 5) never (0% of the time)

APPENDIX 2

An example of one section of the visual efficiency test is reproduced below. The age-normed test contains a total of 150 lines. As the example illustrates, the subject's task is to circle the letters of the alphabet in the order of their appearance in a 5- or 10-min test.

CRANE-WICK VISION and HEARING EFFICIENCY TEST

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	
jio	nb	mic	xd	a	npn	lkl	avx	nju	b	xd	ewz	skl	nvg	gfd	bdeg												1 2 4
uyt	dasb	k	s	far	hgec	pfnc	qwzx	opnc	hsdr	hyw	hdf	mp															1 2 5
hpdm	rtoec	hiu	wiep	wxc	lkje	dhf	nbf	cxv	bedf	phr	mnt																1 2 6
vce	cxw	opl	egq	wxu	mpm	edgu	guyc	whp	yhn	exc	bvr	numu															1 2 7
tc	uji	uy	mopl	bghei	wex	cnvr	ewr	dfs	xsd	asz	zsj	f	pj														1 2 8
swr	tfg	sxd	dju	btyl	ipjl	csk	mwr	pre	dkr	wxc	mkrt	r															1 2 9
awe	drf	gtr	mlr	tew	celb	nrel	vne	mew	zxtrile	wec	vmne																1 3 0
xrtl	xtwp	ctyu	bnut	wrc	ctv	bon	vctr	hnt	lmbn	xt	rotg																1 3 1
vtn	ctop	rctp	xyx	cty	opc	pq	vt	cwed	wqn	opq	svb	dru															1 3 2
cde	frt.	hnt	yru	detr	cd	ghys	mupm	syn	mnu	banv	stm	pom															1 3 3
sbr	pmtl	whtx	wmth	mnuc	xy	puabn	rtyu	mnwu	cbluv	xasy																	1 3 4
myuv	cvt	xtu	plwj	hgn	cvuw	rtl	czl	plik	mxba	nhj	fxh	r															1 3 5
wch	ctt	chu	nhg	fgw	rxv	ghyt	rtw	sedcy	mun	pumz	xy	z															1 3 6

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