VALIDITY OF PHOROPTER-BASED ACCOMODATIVE FACILITY

By

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ABSTRACT

Background: It is of utmost importance for a busy primary care optometric practice to be as efficient as possible. It is just as important to be sure that efficient procedures used in a practice produce valid results. The purpose of this report is to provide data that shows how well Phoropter-Based Accommodative Facility Testing identifies symptomatic patients. Normative data for Phoropter-Based Accommodative Facility Testing has been established on asymptomatic patients. *Methods:* Forty-two subjects aged 8-35 years were evaluated using Phoropter-Based Accommodative Facility. Prior to testing, subjects completed surveys to determine if the subjects had symptoms that are commonly found with accommodative and binocular vision conditions. The near-point PD was put into place and the target that was used was a line of letters 1-2 lines larger than threshold at 40 centimeters. Data was gathered binocularly first using +/-0.75D and then using +/-1.50D facility for all subjects. The +/-0.75D testing protocol was -0.75D over the best corrected visual acuity and the +1.50D retinoscopy auxiliary lens was used to facilitate the test. The +/-1.50D testing protocol was -1.50D over the best corrected visual acuity and the large +3.00D strong sphere knob was used to facilitate the test. The facilitating lenses were put in and out of position and the patient reported if and when the target became clear. The procedure was performed using the same methods of testing and the same subject criterion as previously used in normative data studies. The data from the subjects was analyzed and compared to normative data. *Results:* Asymptomatic patients produced results of a mean of 10.4 cycles per minute (cpm). Symptomatic patients

ACKNOWLEDGEMENTS

The contributions of Robert Carter, OD, FAAO, Michael Cron, OD, FAAO and David Bosak, Optometric Intern in the completion of this project are recognized and appreciated.

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BACKGROUND:

Recent literature, which includes a three-article series, has criticized the validity of historical accommodative facility testing[1]. This series reevaluated the validity of accommodative facility testing using a survey for subjects and correlated the survey with accommodative facility test results[2]. Symptoms were categorized as asymptomatic, which included 0-1 positive results on a survey, borderline which demonstrated 2-3 positive results, symptomatic which included 4 or more positive results. The difference between symptomatic and asymptomatic was statistically significant which correlated with a high probability of symptoms if binocular accommodative facility is < 8 cycles per minute using the standard flipper method of testing[2]. According to a study performed by Wick et al., standard flipper accommodative facility testing using +/-2.00D lenses at a testing distance equal to 45% of the patients accommodative amplitude and a lens power equal to 30% of the amplitude, results demonstrated a 23% sensitivity and a 80% specificity when tested in children 6 to 16 years of age using a less than or equal to 6 cpm failure rate[3]. Adult subjects had a sensitivity of 39% and a specificity of 63% when using a pass rate of greater than or equal to 9 cpm. A failure rate of less than or equal to 7 cpm was used in adults[3]. This "standard" form of testing requires that the proctor have the patient's best refraction and has required the use of trial framing the patient's spectacle prescription. It also requires that the proctor have access to +/-2.00D flippers. This has proven to be inefficient for average busy practitioner and often this test is not performed due to its inefficiency.

"Amplitude-scaled" accommodative facility has shown to have higher rates of sensitivity, (children-76%, adults-93%), and specificity, (children-68%, adults-75%), for both groups of subjects than the standard method previously described. This procedure requires 11 different flippers of powers from +0.75D-+3.25D, Polaroid filters and the use of 31 different testing distances. The combination of flippers used and testing distance were dependent upon the subject's amplitude. This method is extremely inefficient and requires the expense of the equipment previously described.

The purpose of this study is to determine the validity of the efficient form of Phoropter-Based accommodative facility by testing the correlation with cycles per minute with a survey testing for patient symptoms. We also evaluate a pass/fail criterion of 12cpm as passing and less than 12cpm as failing. Normative data for this form of testing has been established prior to this testing. This form of testing does not require a trial frame, flippers, Polaroid filters or any additional special equipment. This procedure can easily be performed in a fraction of the time of the standard method of accommodative facility testing. This test is performed using a phoropter, near point rod, near acuity chart, overhead lamp and a timer such as a wristwatch with a second hand.

METHODS: Forty-two subjects aged 8-35 were tested in this study. Before testing, all subjects read and signed a consent form approved by the Ferris State University Human Subjects Committee. Subjects also completed a survey of accommodative and binocular

vision syndromes symptoms and to define the extent of the symptoms. The subjects then went through a brief examination that included refraction, visual acuities, amplitude of accommodation, near point of convergence, cover test at distance and near, stereopsis, extra ocular motility testing, accommodative lag, and subjective phoria testing. Patients that did not meet visual acuities of 20/20 or better in each eye, those who were strabismic, had a negative lag, had a phoria of greater than 5 prism diopters of esophoria or greater than 10 prism diopters of exophoria, and those who lacked normative amplitude of accommodation were not included in the study. The examiners were blind to the survey results during testing.

Table 1: Exculsion criteria

Criteria for exclusion	**Exclusion Values [Specific Test Used]**
Visual Acuity-Distance and Near	>20/20 in each eye [Snellen Acuity]
Pre-existing Strabismus/Phoria Outside Range	Any tropia, >10pd Exophoria; >5pd Esophoria [Cover testing]
Lag of Accommodation	<+0.25 or >+0.75 [Nott Retinoscopy]
Amplitude of Accomodation	<18.5-(.30 x age) [Push up Method]
Extra-Ocular Motilities	Any restriction in motion [Versions]
Age	<8 years; >35 years

Testing: Subjects were seated in an examination chair and placed behind the phoropter which contained their best correcting distance lenses. The phoropter was set for the

subjects near pupillary distance and the standard Snellen near point target was placed at 40cm on a near point rod. A suppression check was previously employed with the stereopsis pre-screening. The near target was fully illuminated using an overhead lamp. Standard accommodative facility instructions were given to the subjects and the subjects were instructed to look through the phoropter at the target. Testing using both +/- 0.75D and +/-1.50D was performed on all subjects.

Procedure for +/- 0.75D: The subject was instructed to look at a near target which was 1 to 2 lines above his/her threshold Snellen Acuity. -0.75D of power was quickly added binocularly to the subjects best corrected refraction using the phoropter. As soon as the subjected reported that the target was "clear," the auxiliary retinoscopic lenses were introduced binocularly. The retinoscopic lenses were +1.50D which turned the initial -0.75D into +0.75D over the distance correction. The subject again would report "clear" as soon as the target was focused and the +1.50D retinoscopic lenses were removed binocularly which changed the +0.75D over the distance correction back to -0.75D. Performing this procedure allowed for a simulated +/-0.75D "flipper" to be introduced along with the best distance refraction in the phoropter. This procedure was repeated for 30 seconds and the number of cycles of +/-0.75D was recorded.

Procedure for +/-1.50D: The patient was given a brief rest period. -1.50D was quickly introduced over the patients distance correction binocularly. As soon as the subject reported the target was "clear," +3.00D was introduced using the large sphere wheel to

make +1.50D over the distance correction. The subject would again report the target was "clear" and immediately the -3.00D large sphere lens would be introduced. This procedure was repeated for 30 seconds and the number of cycles was immediately recorded. This function was used to simulate +/-1.50D "flipper."

RESULTS:

The mean cycles per minute for both +/-0.75 and +/-1.50 are both listed in Table 2. We considered subjects to have "passed" the test if they achieved 12 cpm or more for both +/-0.75D and +/-1.50D. The results for these means were achieved by assessing the number of cycles per 30 seconds the subject achieved and converting this figure to cycles per minute. However, when the subject reached 6 cycles in 30 seconds, (12 cpm), the test was stopped due to meeting the passing criterion for the test. All subjects that would have achieved more than 12 cpm, (for both symptomatic and asymptomatic groups), were measured as having 12 cpm. The mean cycles per minute for asymptomatic subjects are higher than symptomatic patients. Sensitivity for testing was 68.75% and specificity was 43.75%. Chart 1 demonstrates the data. Chart 2 demonstrates the extent of symptoms each group expressed. Charts 3 and 4 demonstrate analysis of the raw data including chi squared values for passing and failing groups.

TABLE 2: Mean, Symptom Comparison

	Asymptomatic (0-1+ results on survey)	Symptomatic (2+ results on survey)
Mean CPM for +/- 0.75D	>12	>12
Mean CPM for +/- 1.50D	10.4	9.55
Slightly Symptomatic	0.8	5.5
Somewhat Symptomatic	0	1.22
Often Symptomatic	0	0.35
Mostly Symptomatic	0	0
Always Symptomatic	0	0

CHART 1: Mean, Symptom Comparison

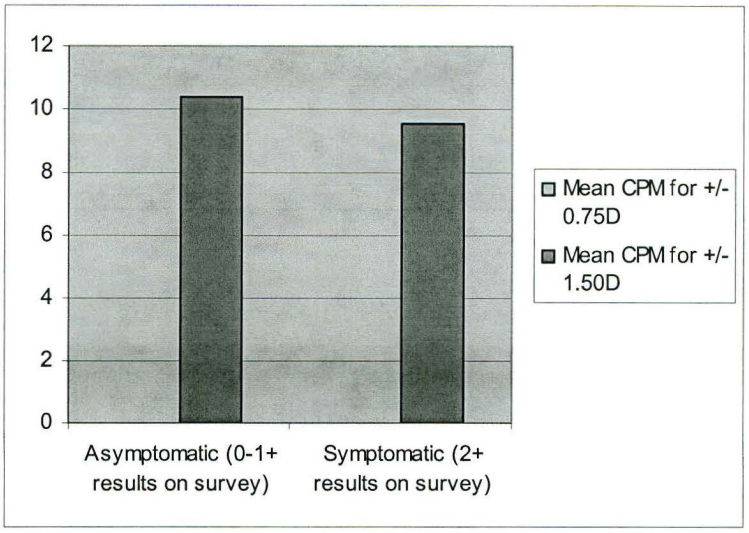


CHART 2: 1-Asymptomatic, 2-Symptomatic Survey Comparison

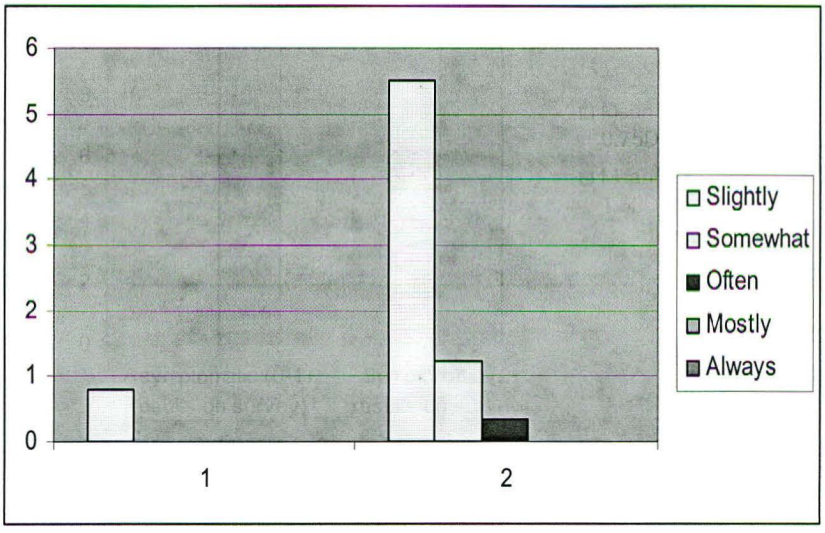
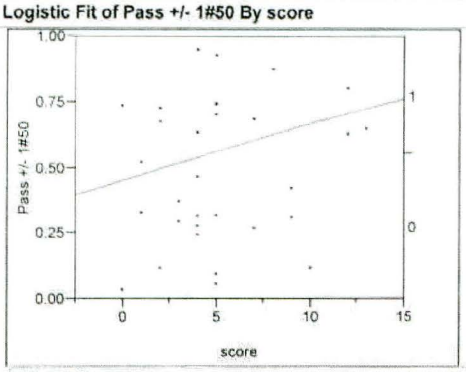


CHART 3: Pass and Fail Logistics for +/- 1.50D

daws- Logistic

Logistic Fit of Pass +/- 1#50 By score



Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	0.346209	1	0.692418	0.4053
Full	21.583846			
Reduced	21.930055			

RSquare (U)	0.0158
Observations (or Sum Wgts)	32

Converged by Gradient

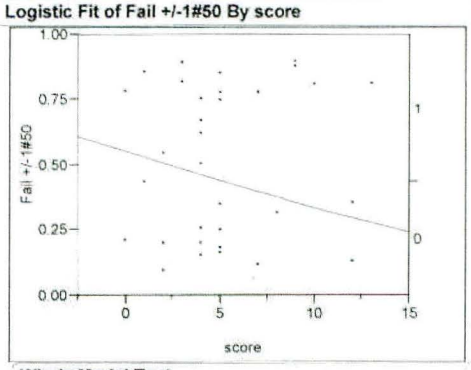
Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-0.2064609	0.6584639	0.10	0.7539
score	0.09073514	0.1113229	0.66	0.4150

For log odds of 0/1

daws- Logistic

Logistic Fit of Fail +/-1#50 By score



Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
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score	-0.0907351	0.1113229	0.66	0.4150

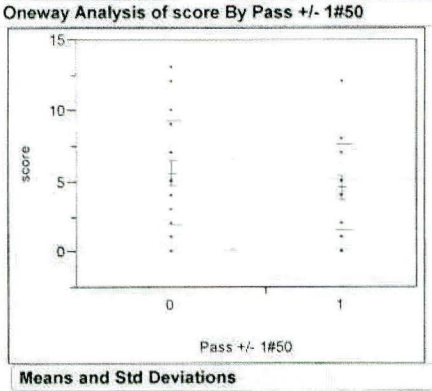
For log odds of 0/1

CHART 4: Oneway Analysis of Pass Fail Criterion for +/- 1.50D

daws- Oneway

Fit Y by X Group

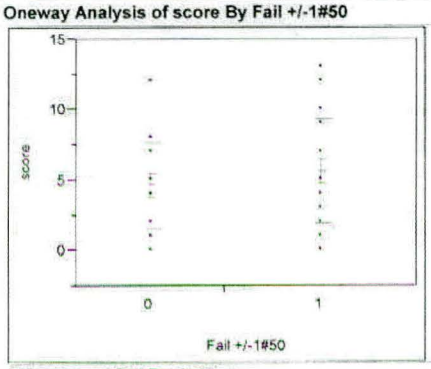
Oneway Analysis of score By Pass +/- 1#50



Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
0	18	5.55556	3.68179	0.86781	3.7246	7.3865
1	14	4.57143	3.05625	0.81682	2.8068	6.3361

Oneway Analysis of score By Fail +/-1#50



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1	18	5.55556	3.68179	0.86781	3.7246	7.3865

DISCUSSION:

Current methods of testing currently used include the "amplitude scaled" and "standard" methods. These methods need the use of flippers, the patient's updated prescription to be trial framed Polaroid filters or vectographic targets for suppression checks and the patient to be moved away from the phoropter. These tools are not typically a part of the primary care examination setting and are considered to be specialty equipment. The "amplitude scaled" test requires even more specialty equipment than the "standard" method by requiring 11 different lens powers and multiple test distances which makes this test the most inefficient of the three types of testing discussed. These characteristics make accommodative facility an under utilized test in the primary care setting. Utilizing the Phoropter-Based accommodative facility method does not require any additional equipment, movement of the patient, has a standardized testing distance and is an incredibly efficient method producing similar results to the standard method of testing. The efficiency of this method allows practitioners to incorporate this test into a routine that already includes other near point tests.

Suppression checks were not employed during the test but the testing for stereopsis prior to phoropter based accommodative facility utilized suppression checks. This is an example of similar testing protocol that would be used in an efficient primary care setting.

Zellers et al.'s[3] has performed a study comparing the "standard" method with a survey to test for a correlation between symptoms and accommodative facility results. Zellers et al.'s[3] criterion for passing using the "standard" method was greater than or equal to 8 cpm binocularly. Criterion for failure was less than or equal to 3 cpm. Zeller's testing was completed using +/-2.00D flippers. The symptom criterion Zeller's used was asymptomatic patients reported 0-1 symptoms, borderline symptomatic patients reported 2-3 symptoms, and symptomatic patients reported 4 or more symptoms. Levine et al.[3] found a trend that accommodative facility decreases with increased symptoms. Despite this conclusion this same study did not find a direct correlation between accommodative facility and asthenopic symptoms. Our phoropter based technique also demonstrated that accommodative facility decreases with increasing symptoms.

Hennessey et al.[2] associated accommodative facility decreasing with increasing symptoms. The subjects for this study were between the ages of 8-14 years of age. Multiple studies recognize that facility studies with adult subjects produce different and more likely to be unreliable results in comparison to studies with children. Our population consisted of primarily adult subjects and the difference in accommodative facility was not statistically significant between symptomatic and asymptomatic groups. Should the study have consisted of primarily subjects 8-14 years of age the results may have more closely correlated with the study by Hennessey et al.

The data presented regarding phoropter based accommodative facility and the correlation to patient symptoms will allow the practitioner to determine if a patient's symptoms are due to an accommodative condition. The test is able to be performed monocularly although monocular normative data and data relating findings to symptoms have not been established monocularly. Normative data for phoropter based accommodative facility has been established binocularly.

Our study using phoropter-based accommodative facility compared the data found with a survey similar to the Zeller et al.[3] study. A decline in the mean cycles per minute of accommodative facility is demonstrated in the symptomatic group. Our sensitivity, specificity and chi squared comparison of passing and failing groups for +/-1.50D did not produce a statistically significant result with group of subjects tested, passing criterion and utilizing the symptom survey used.

CONCLUSIONS: Phoropter based accommodative facility testing produces similar results to the "standard" method of testing. Both of these types of testing demonstrate as symptoms occur and increase, accommodative facility cycles per minute decrease. However further research is needed to determine the validity of method of testing in children.

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