Article ▸ Comparison of CISS Score with Fixation Disparity as Measured with the Wesson Card

Clinton Prestwich, BS, Southern College of Optometry Class of 2017

Patricia Cisarik, OD, PhD, Associate Professor, Southern College of Optometry

Optometrists Change Lives Writing Competition 2016 Winner

ABSTRACT

Background: Inclusion criteria for validation of the Convergence Insufficiency Symptom Survey (CISS) did not include fixation disparity (FD); thus, the relationship between CISS score and FD is unknown. This study compared FD and CISS score in a young, healthy graduate student population.

Methods: Subjects (n=161) aged 22-42 years, with good acuity OU and no strabismus, completed the CISS and were evaluated for horizontal phoria and FD (Wesson card) at near. Subjects were separated by CISS score into HIGH (≥21) or LOW (<21) groups. Student t-test samples and one-way ANOVA were used for within- and between-group comparisons of mean FD and phoria.

Results: Comparison of HIGH vs LOW CISS score groups showed no difference in magnitude of FD for any subgroup. Within the HIGH CISS score group, no difference in means was found for CISS score or magnitude of phoria among the 3 subgroups or for FD magnitude between eso and exo FD subgroups. Within the LOW CISS score group, no difference in means was found for CISS score or magnitude of phoria among the 3 subgroups; magnitude of FD was significantly different between eso and exo FD subgroups (p=0.005). Comparisons between HIGH and LOW groups for exo, eso, and no FD subgroups showed that mean CISS scores were significantly different for all subgroup comparisons (p<0.001); however, mean near phoria was different only for the exo FD subgroup (p=0.01).

Conclusion: Neither the magnitude nor the direction of FD as measured with the Wesson card could be predicted by CISS score group.

Introduction

Good clinicians are constantly seeking to improve the efficiency of their examinations by quickly and accurately arriving at diagnoses based upon a patient's presenting symptoms. Through correct identification of problems based upon symptomology, doctors are able efficiently to streamline data collection and to conduct problem-focused exams. Examinations conducted in this manner improve both patient response and overall experience.

Symptom questionnaires have been created to screen for certain disorders, assisting doctors as they attempt to perform problem-focused exams. Among these questionnaires, several surveys have been developed to screen for near vision symptoms, but only a few have been validated.[1] At least one of these validated surveys, the Convergence Insufficiency Symptom Survey (CISS), did not include horizontal fixation disparity (FD) in the inclusion criteria for validation;[2] thus, the relationship between CISS score and horizontal FD is unknown.

FD is a minute ocular misalignment, usually less than 10 arcmin, which occurs during binocular viewing. FD allows for slight "slippage" in the precise placement of images on

corresponding retinal points through sensory fusion.[3] FD is measured by providing the viewer with a target that demonstrates two types of stimuli: peripheral binocular stimuli that allow for fusion lock and central monocular stimuli whose level of alignment or misalignment is perceived and reported by the viewer.

Several studies have linked FD and binocular vision symptomology. Mallett argued that the presence of FD will nearly always be accompanied by symptoms.[4] Additionally, Yetka and Pickwell performed a study whose results support Mallett's claims. Using a modified Mallett unit on a population of Iranian optometry students, they found that the mean FD of symptomatic subjects was significantly higher than that of asymptomatic patients.[5]

In 1978, Sheedy and Saladin identified several clinical measures that could be used to discriminate between asymptomatic and symptomatic students in a graduate school population.[6] In their study, they demonstrated that the FD (described as the Y-intercept of a person's forced FD curve) was the best discriminator for symptomatic exophores among the variables tested. To determine whether a subject was asymptomatic or symptomatic, Sheedy and Saladin used a symptomatic questionnaire of their own design that differs greatly in both form and methodology from the CISS.

Due to the evidence of an association between FD and the presence of near binocular symptoms, identification of a correlation between FD and the currently more widely used CISS would be clinically useful. This study compared horizontal FD as measured with the Wesson fixation disparity card and CISS score in a young, healthy, graduate student population.

Methods

This study was conducted in compliance with the tenets of the Declaration of Helsinki and received approval from the Institutional Review Board at Southern College of Optometry in Memphis, TN. Informed consent was obtained from each participant.

Participants in this study included 161 subjects aged 22-42 years. Inclusion criteria comprised the following: 20/20 visual acuity OD, OS, OU at near (40 cm), no strabismus or history of strabismus surgery, and not currently taking any medications that might affect eye movement. Although not a criterion for participation, subjects were also characterized as engaging in near work for a large portion of their waking hours on a daily basis due to their vocation as optometry students.

Each subject completed the revised CISS (Figure 1). The revised CISS asks a series of 15 questions. In response to the questions, subjects may choose one of five options to describe the frequency at which the queried symptoms occur. These options are Never, Infrequently, Sometimes, Fairly Often, and Always. Scoring of the survey is based upon the response, and each question is awarded 0, 1, 2, 3, or 4 points, respectively. The points for all questions are summed to produce an overall score. For adults, a score of ≥21 is used to distinguish between normal and abnormal levels of symptoms.[7]

The examiner, blind to CISS scores, evaluated each subject's horizontal phoria at near using a Maddox rod and neutral fixation light presented at 40 cm. Upon placement of the Maddox rod and introduction of the light, the subject was asked where the line image created by the Maddox rod was perceived in relation to the light. If the subject reported that the two images were not aligned, prism was introduced monocularly using a prism bar until the subject reported the light and line image were superimposed. The neutralizing prism direction and magnitude were recorded.

Horizontal FD was measured at 40 cm using the Wesson card. The measurement of the FD was obtained by directing the subjects to view the Wesson card presented on the near rod of the phoropter through polarized lenses

Answer the following questions by circling the frequency with which you have the described symptoms:

1. Do your eyes feel tired when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

2. Do your eyes feel uncomfortable when doing reading or close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

3. Do you have headaches when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

4. Do you feel sleepy when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

5. Do you lose concentration when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

6. Do you have trouble remembering what you have read?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

7. Do you have double vision when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

8. Do you see the words move, jump, swim, or appear to float on the page when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

9. Do you feel like you read slowly?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

10. Do your eyes ever hurt when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

11. Do your eyes ever feel sore when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

12. Do you feel a 'pulling' feeling around your eyes when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

13. Do you notice the words blurring or coming in and out of focus when reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

14. Do you lose your place while reading or doing close work?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

15. Do you have to re-read the same line of words when reading?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Fairly Often ☐ Always

Figure 1. Revised Convergence Insufficiency Symptom Survey (CISS)
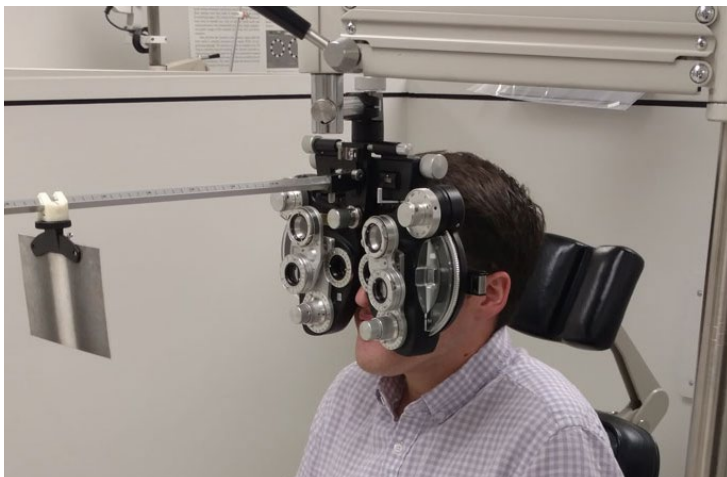

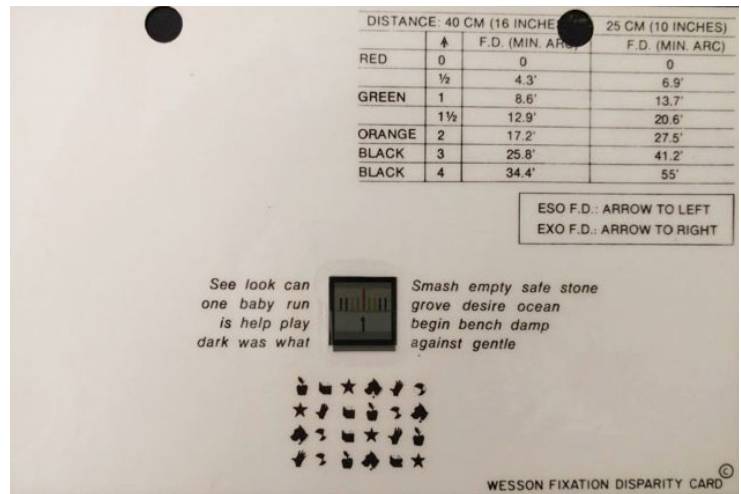*Figure 2.* Measuring horizontal FD with Wesson FD card.

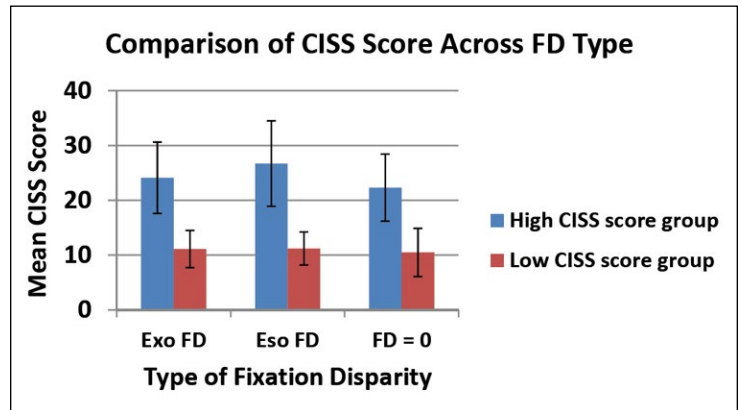*Figure 3.* Wesson fixation disparity card.

Figure 4. Within-group comparisons of CISS score across FD type.

(Figures 2 and 3). The subject was asked to identify the target line to which the arrow was pointing. The level of FD corresponding to the subject's response was recorded.

Subjects were separated by CISS score into HIGH (≥21; n=51) or LOW (<21; n=110) groups using the validated criteria. Within each group, three FD types were identified: exo, eso, and no FD. The distribution of FD type was calculated for each CISS score group.

Student t-test for independent samples and one-way ANOVA were used for within- and between-group comparisons of the means for FD magnitude. Additionally, comparisons were made between CISS score groups for phoria magnitude.

Results

Figure 4 illustrates the validation of the cutoff score of 21 to separate the HIGH CISS score from the LOW CISS score groups. The mean CISS score for each FD type was
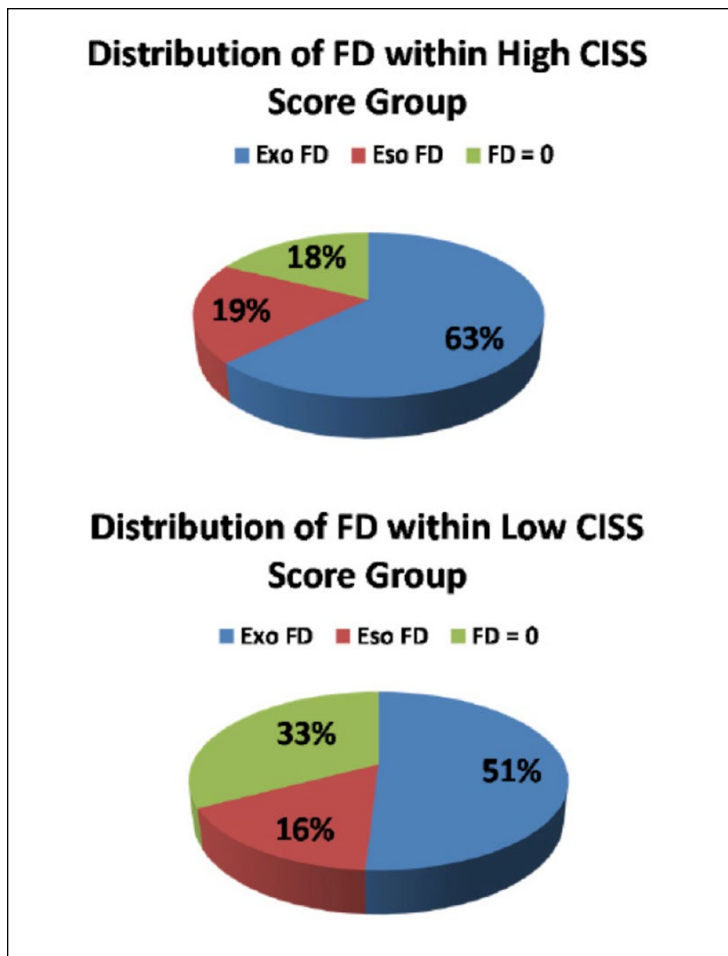
Figure 5. *Comparison of the distribution of FD type within each CISS Score group. Top: Distribution of FD type for 51 HIGH CISS score subjects. Bottom: Distribution of FD type for 110 LOW CISS score subjects.*

Figure 6. *Within-group comparisons of mean magnitude of FD.*
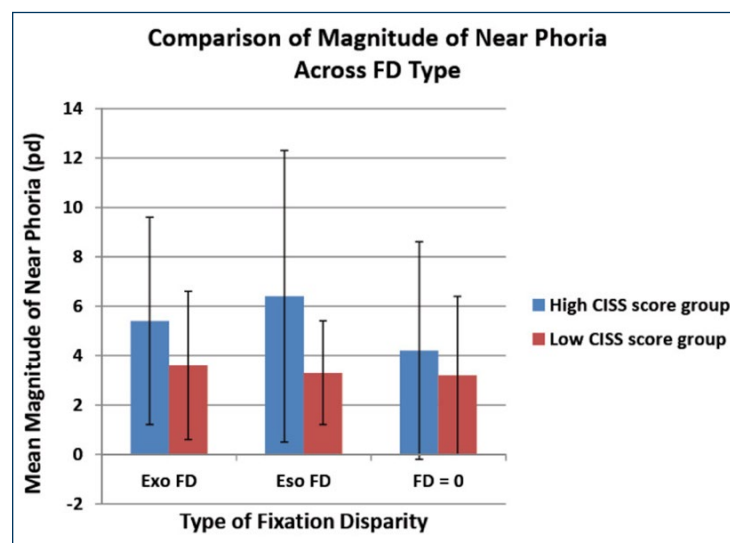
Figure 7. *Within-group comparison of mean near phoria across FD type.*

significantly different between HIGH and LOW CISS score groups (p<0.001).

Figure 5 shows the distribution of FD type within each CISS score group, HIGH and LOW. The two distributions were not significantly different (p=0.14).

As shown in Figure 6, when comparing mean FD magnitude of each subgroup (exo or eso) across CISS score group, no significant difference was found. When making within-group comparisons, a significant difference in mean FD magnitude was found only in the LOW CISS score group between those with exo versus eso FD (p=0.005).

Figure 7 illustrates the comparison of mean near phoria across FD type and CISS score group. Only the difference in mean near phoria between the HIGH CISS score subjects with exo FD and the LOW CISS score subjects with exo FD was significant (p=0.01).
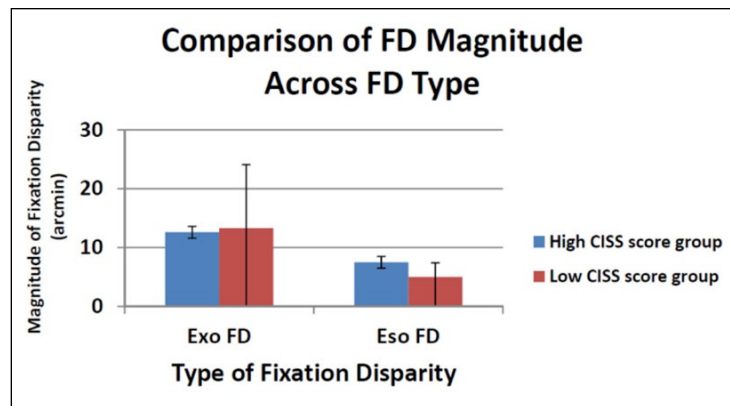
Discussion

The results of this study are dissimilar from the previous work done comparing FD and symptomology. However, several reasons may explain the different outcomes. First, the symptoms quantified by the CISS are different from those measured in older studies. As previously mentioned, the questionnaire used by Sheedy and Saladin is substantially different from the CISS. Yetka and Pickwell did not specify the criterion used to differentiate symptomatic from asymptomatic subjects in their study. These differences could well account for our divergent results. If the classifying criteria for symptomatic or asymptomatic are not equitable, dissimilar results are not surprising.

Second, the method of measuring FD in this study was different from that of previous studies. Yetka and Pickwell used a modified Mallett unit. Sheedy and Saladin used the

Sheedy disparometer. The Wesson card was used in the current study. Each of these methods of measuring FD may yield different results due to unique fixation targets, diverse lighting, and different mechanisms to induce peripheral fusion lock. While not comparing the Wesson card to the other methods of measuring FD above, Ngan et al. demonstrated that FD as measured with the Wesson card was significantly different from that measured with the Saladin card.[8] One may reasonably expect that the varying methods of measuring FD would be comparable; however, their differences have been demonstrated and may contribute to our disparate results. Given that the Wesson card is less costly, which may make it more widely available for clinical use, identifying differences in test results using this instrument compared to results obtained with other instruments is clinically important.

The differences between the current study and previous studies could have been avoided by designing our study to mimic those done in the past. However, the purpose of our study was not to evaluate whether FD is associated with near vision symptomology in general, which was the objective of past work. Rather, our study was designed to evaluate whether the CISS, a frequently used, validated symptom questionnaire, could be used to predict FD as measured by a method very commonly found in practice in the United States, the Wesson card. Thus, the dissimilarities exist by design in order to achieve our objective.

Finally, there have been recent studies further evaluating the validity of the CISS. Horan et al. found that self-administered CISS scores like those performed in the current study were significantly higher than CISS scores recorded by physician-administered surveys.[9] Inflated scores due to self-administration in our study would have placed patients without convergence insufficiency (CI) in the HIGH group and possibly cause a shift in mean group FD.

Additionally, Clark and Clark examined the effect of the emphasis on reading inherent to the CISS questions. They demonstrated that when subjects were asked questions comparable to those contained in the CISS, replacing "reading" with a favorite near activity, the mean CISS score was significantly lower. They postulated that because the CISS emphasizes reading, the score might not specifically correlate to the reduced convergence and accommodative functions that define CI, but instead correlate with the higher cognitive processes involved in reading that are not engaged with other types of near activities.[10] This theory may be applied to the current study. The participants were characterized as engaged in reading for significant amounts of time on a daily basis due to their status as optometry students. Because of the fatigue associated with this elevated reading time, and due to the emphasis placed on reading in the CISS questions, the subjects may have inflated CISS scores. Again, inflated CISS scores may have placed non-CI subjects in the HIGH score group, altering the mean FD for the group.

Conclusions

Neither the magnitude nor the direction of FD as measured with the Wesson card could be predicted by CISS score group in this population of graduate students. Therefore, the CISS as presently constructed should not be used to predict or infer any information regarding FD.

References

1. García-Muñoz Á, Carbonell-Bonete S, Cacho-Martínez P. Symptomatology associated with accommodative and binocular vision anomalies. J Optom 2014;7:178-92. http://bit.ly/2dY7jb0

2. Borsting EJ, Rouse MW, Mitchell GL, Scheiman M, et al. Validity and reliability of the revised convergence insufficiency symptom survey in children aged 9 to 18 years. Optom Vis Sci 2003;80:832-8. http://bit.ly/2d0k2be

3. Sheedy JE. Actual measurement of fixation disparity and its use in diagnosis and treatment. J Am Optom Assoc 1980 Dec;51(12):1079-84. http://bit.ly/2dPjILx

4. Mallett RF. Fixation disparity—its genesis and relation to asthenopia. Ophthal Optician 1974;14:1159-68.

5. Yekta AA, Pickwell LD. The relationship between hetero-phoria and fixation disparity. Clin Exp Optom 1986;69:228-31. http://bit.ly/2dFIb4t

6. Sheedy JE, Saladin JJ. Association of symptoms with measures of oculomotor deficiencies. Optom Vis Sci 1978;55:670-6. http://bit.ly/2cPSMhz

7. Rouse MW, Borsting EJ, Mitchell GL, Scheiman M, et al. Validity and reliability of the revised convergence insufficiency symptom survey in adults. Ophthal Physiol Optics 2004;24(5):384-90. http://bit.ly/2d0k2be

8. Ngan J, Goss DA, Despirito J. Comparison of fixation disparity curve parameters obtained with the Wesson and Saladin fixation disparity cards. Optom Vis Sci 2005;82:69-74. http://bit.ly/2cQcZPi

9. Horan LA, Ticho BH, Khammar AJ, Allen MS, Shah BA. Is the convergence insufficiency symptom survey specific for convergence insufficiency? A prospective, randomized study. Am Orthop J 2015;65:99-103. http://bit.ly/2dFLecO

10. Clark TY, Clark RA. Convergence insufficiency symptom survey scores for reading versus other near visual activities in school-age children. Am J Ophthalmol 2015;160:905-12. http://bit.ly/2doB3Pr