THE SYMPTOM FACTOR

VALUES OBTAINED FROM A NORMAL POPULATION

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APRIL 19, 1988

ABSTRACT

To establish a range of "S factor" (Symptom factor) values from a normal population. The S factor is the ratio of near convergence(BO)/near point of convergence(NPC). The S factor has been shown to have a relationship with symptomatic versus asymptomatic patients in studies by Shippman et al, subjects with a low S factor were found to have a high correlation of experiencing near point symptoms. The subjects were one hundred twenty three fifth grade students from the Big Rapids school system. The following criteria were used, 20/40 or better visual acuity at distance and near, and 60 seconds of stereopsis or better at near. Data was generated from one hundred and eight patients that met the criteria.

INTRODUCTION

One of the most common oculomotor problems is convergence insufficiency(CI). CI is a syndrome characterized by a reduced near point of convergence, greater exophoria at near than distance, reduced relative negative accommodation, and reduced positive fusional convergence. Commmon symptoms from CI include headaches, asthenopia, drowsiness, blurring of print, and diplopia when doing near point work. A study by Kratka found 25% of a sample of 500 patients demonstrated findings indicative of CI.

Many studies have been done to show that CI responds well to visual training. That is patients report a reduction in symptoms, and clinicians find a improvement in abjective data. Lyle and Johnson reported that 93% of 300 patients trained were cured or improved. Mayou reported 79% of 420 patients trained were cured or improved. This is just two of many studies conducted that had high success rates of training CI patients. Because of the high incidence of CI patients in the population and the great success in training them, identification and treatment of these patients is essential. Even CI's without symptoms should be trained because concentration and attention have been shown to improve after CI training.

An excellent way of identifying a symptomatic patient is to perform horizontal forced vergence fixation disparity curve (HFDC) with the disparometer. Fixation disparity is a small misalignment of the two eyes which occurs during binocular fusion. HFDC measures the binocular system during fusion and how well it reacts to stress. Fixation disparity is measured with three prism diopter increments base in and base out until fusion can't be maintained, then it is plotted. The slope as the curve passes the Y axis is indicative of oculomotor balance. A steep slope indicates poor oculomotor balance, and a flat slope indicates good oculomotor balance. Problems with the HFDC include difficulty in administering to young patients and poor subjective responders. It is also time consuming, difficult for some patients to understand and influenced by shifting accommodative levels. While the HFDC can give good clinical information, sometimes it is unreliable due to the above listed problems.

The S factor was introduced by Shippman et al in attempts to find a test that yields good information about oculomotor balance, is easy to administer, and also objective. Shippman found high correlation between the S factor and CI. Sixty eight percent of the CI's had a S factor of three or less, and seventy nine percent had a S factor if four of less.

A study done by Wrubel found that 88.9% of symptomatic CI's had a low S factor and 84.6% of asymptomatic patients had high S factors.

The S factor is also good for identifying CI's that have relatively normal NPC and convergence amplitudes but still suffer from near complaints. The purpose of this research is to establish a range of S factor values from a normal population of the same age group.

METHOD

One hundred twenty three fifth grade students participated in the study. Children of the same age were used to get a normal as possible cross section of data. The children were screened on two criteria, first, 20/40 or better acuity at both distance and near, and secondly, 60 seconds or better of stereopsis at near. Acuity was measured with a standard Snellen acuity chart at distance. Near acuity was measured with a reduced Snellen acuity chart. The stereo reindeer test was used at near to measure stereopsis. If the children met the above two criteria, then they were tested for the S factor. Of the one hundred twenty three children, one hundred eight met the requirements.

Near convergence (base out to break) was measured with the large horizontal vergence bar with prism power up to 40 prism diopters. At higher powers the power increases in increments of five prism diopters. The end point was the objective noting of the eye turning out, although in many cases diplopia was reported before the eye turn was seen. If the child reported diplopia, that was the end point. The target for the base out to break was the standard reduced 20/20 row of vertical letters. Lower measured base out values are expected when convergence is measured with jump versus ramp (Risley prisms) installation of

prism. The prism bar has the advantage over the Risley prisms in that objective feedback can be obtained, due to direct observation of the eyes. Also it is more natural of a situation than when a patient is behind a phoropter.

The NPC was determined with a block af reduced 20/20 Snellen letters. The patient was advised to keep the target single. The endpoint was objective noting of when the eyes dissociated. NPC was measured from the corneal apex.

RESULTS

Of the fifteen subjects that didn't meet the screening criteria, five were because of decreased stereopsis. Seven were screened because of decreased distance visual acuity, one for decreased near acuity, and two for unequal acuity between the two eyes. Seventeen children were referred for primary care exams, eleven for decreased viaual acuity, and six for convergence or stereopsis problems.

Statistical analysis was done on a sample size of one hundred eight subjects that meet the screening criteria. Results were as follows, the overall mean S factor was 6.4 with a range of 0.8 to 16.0. The standard deviation for the S factor was 3.8. It is interesting to note that the mean S factor of 6.4 found in this study is almost identical to the 6.5 found by Wrubel to differentiate between symptomatic and asymptomatic patients.

DISCUSSION

There is a interesting correlation found between the mean S factor of 6.4 found in this study and the 6.5 S factor cutoff used by Wrubel. The 6.5 S factor was determined to be the cutoff number, below 6.5 implying low/symptomatic and above 6.5 as high indicating no symptoms. The 6.5 value was determined by adding one standard deviation to the low/symptomatic mean S factor and subtracting one standard deviation from the high asymptomatic mean S factor. While this is a interesting correlation, it must remembered that Wrubel used only exophore's for his research.

There is a overlap of the second deviations, the one on the high side of the symptomatic patients, and on the low side of the asymptomatic patients. This gives a area around 6.5 where it becomes hard to interpret the S factor results. Based on the results of these two studies, it appears we are right back we started from. We still have the area around the mean where a patient can be symptomatic or asymptomatic. It appears the S factor is not a definitive test, but another tool to be used to give the clinician more information.

Previous reseach by Shipmann et. al. and Wrubel have shown a high correlation between symptomatology to high/low S factors. There needs to be more research with larger numbers of subjects

done to find a guideline S factor that points to symptomatic versus asymptomatic patients. Before this research is to be done more needs to be understood about how the S factor is measured, and what the basis is for it's relationship to symptomatic patients.

The NPC endpoint is very consistent. Almost all patients will exhibit a large eye turn upon diplopia that is easily observed. Due to the great amount of convergence from the proximity of the target, once diplopia is experienced, convergence is released and the eyes turn out. Because CI is primarily the fault of the disparity detectors, voluntary convergence instead of disparity driven convergence can cause the NPC to be a lower value, and thus be a misleading result.

The base out to break endpoint is more obscure, many times the patient will report diplopia before there is a associated eye turn. This indicates that the positive fusional convergence is being held in hopes of regaining single binocular vision. This aspect would be measured by base out recovery. The less the degree to which positive fusional convergence is released, the smaller amount of base in prism is required to regain fusion. The picture is further clouded because accommodative convergence can be used to keep the target single. To some degree, voluntary

convergence can be used to maintain single binocular vision. There appears to be many factors affecting the BO values, and thus affecting the consistency of the measurement of the S factor.

It is interesting to note that some eyes hold the two separated images close together, where other eyes give up immediately and let them separate far apart. Could BO recovery be an indication of strength of the binocular system? Systems that work hard to hold an image single potentially may have less nearpoint symptoms. Visual systems that easily give up and experience a large eye turn, may be prone to experience near point symptoms more frequently. Ease of release of the positive fusional convergence, measured by BO recovery, as it relates to nearpoint symptoms would make an interesting research topic.

In summary, there is much potential for the S factor test. It is a fast, easy and basically objective test. The only skill demanded from the patient is fixaton so it is very useful for those patients that give unreliable subjective responses. The S factor is not a substitute for other tests, but a supplement to other testing to help in making a diagnosis.

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