

TEMPORAL CHARACTERISTICS OF INTERMITTENT CENTRAL SUPPRESSION

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Abstract

Intermittent central suppression (ICS) is a repetitive suppression of central vision in non-strabismic/non-amblyopic individuals. Preliminary estimates have been made of the temporal and spatial characteristics of ICS. ICS has been implicated in reading problems.

We examined 30 non-strabismic/amblyopic ICS patients in a private optometric practice. We video documented the suppressions, and later these suppressions were stopwatch timed. Three hundred sixty-five individual suppressions among these thirty ICS suppressors and the associated periods of simultaneous sight were timed. We found these ICS suppressions to average 2.6 seconds OD, 3.0 seconds OS. The intervening ("binocular") periods of simultaneous sight averaged 3.4 seconds. Younger patients tended to have longer suppressions, adults shorter suppressions.

A proposed clinical rule of thumb fitting these temporal characteristics defines ICS as a non-constant, non-strabismic repetitive suppression of the central field occurring at least twice during a 10-second period. Since ICS affects reading, it should be treated. When ICS is present, active anti-suppression vision therapy must be considered the standard of care and in accordance with accepted principles of medical care should be considered medically necessary and appropriate.

Key Words

dyslexia, intermittent central suppression, suppression, temporal characteristics, vectographic binocular refraction, visual dyslexia

Introduction

Optometric diagnosis of non-strabismic suppression and discussion of its significance has had a long history in clinical optometry. The written documentation of non-strabismic suppression and the demand for its treatment started with Louis Jaques, Sr. In 1950 and again in 1956, he stated that such a suppression was the first and most important deficit to treat with vision therapy.^{1,2} Jaques did not discuss diagnostic criteria, but concentrated instead on therapy.

In 1964 Strauss and Immerman proposed a clinical definition of non-strabismic suppression, using the term "macular suppression."³ They defined this condition as "an involuntary, temporary suspension of vision in one or both eyes" in non-strabismic subjects. Their diagnostic instrument was the stereoscope, and they found a significant link of this repetitive suppression to reading problems.

Louis Annapole introduced the term "intermittent central suppression" in 1967 and suggested its relationship to poor reading performance.⁴ The name "intermittent central suppression" implies non-constant suppression of the central area of vision, paralleling Strauss and

Immerman's macular (i.e., central visual area) suppression. I further refined the definition of intermittent central suppression (ICS) as a repetitive suppression of the central area of vision in non-strabismics and non-amblyopes.⁵

While Strauss and Immerman found a compelling link between ICS and reading problems, other literature on suppression and reading did not.⁵ I contended this was a function of testing. Often, strabismus- or strabismus-derived-suppression tests have been used inappropriately to determine non-strabismic suppression. I found that a representative group of strabismus and amblyopia-derived suppression tests missed diagnosing ICS that were found with routine vectographic testing. In fact, these strabismus-derived suppression tests didn't even agree with each other when testing non-strabismics. Obviously, tests that are assumed to diagnose the same condition, but don't agree with each other could confound the literature on that condition. The flaw may simply be assuming that strabismic and non-strabismic suppression are precisely the same entity and therefore, any accepted tests for one are automatically valid for the other. This confusion in the literature prompted my proposal that ICS was "a missing link in reading problems."⁵

The "missing link" paper was the first to establish some valid, reliable testing and also the first attempt to quantify the temporal characteristics of ICS. These results suggested a typical ICS suppression

to be a 2 to 5-second suspension of central vision, repeating at least once during a ten second period. This group of ICS patients tended to have eye movement and accommodative deficiencies, but the refractive condition was shown to be minimal: that is, distance correction was such that typical vision screenings would be passed and the public might consider acuity “almost perfect.”⁶ Refractive condition, therefore, was not a good predictor of non-strabismic suppression (ICS), unlike the commonly significant refractive conditions of strabismus and amblyopia.⁷ ICS suppressors tended to have specific reading complaints. The documented vectographic (or stereoscope³) test techniques apparently efficiently diagnose ICS during routine examination.^{8,9}

The genesis of suppression has been documented only once. Routine ICS examination, as mentioned above, and outlined elsewhere,^{8,9} allowed diagnosis of ICS caused by whiplash cervical trauma.¹⁰ In one of these patients, the complete “loop” of cause, effect, remediation and recovery was shown: ICS appeared time-linked to and therefore an apparent consequence of whiplash trauma. Concurrently reading suffered. Specific anti-suppression therapy eliminated the ICS. Reading then returned to subjective pre-trauma levels. The whiplash-ICS patient who showed the complete loop from cause back to recovery was a third demonstration that ICS could be treated successfully, with concurrent improvement in reading.^{8,11} I’ve suggested, based on target sizes used in testing and patient responses, that the suppression zone is perhaps the central 1 to 3 degrees of vision, reflecting a regionalization of the visual field that is accessible through alternating flicker.¹²

As a result of this ICS diagnosed after cervical trauma, I suggested the area of the Lateral Geniculate Nucleus (LGN) would be a logical locus of the ICS suppression. This follows from the anatomy. The LGN straddles the brain stem. Whiplash has been shown to damage the brain stem. Therefore, suggesting the LGN as the locus of the damage that created the suppression, and therefore of ICS itself is logical.¹⁰ If accurate, suppression, and specifically ICS would therefore be an afferent neurological defect. An hypothesized afferent visual defect (ICS), then, has been linked to reading problems that we might label “symptoms of dyslexia.”

I’ve pushed this concept further recently by suggesting that ICS is, in fact, the clinical diagnosis of visual dyslexia and magnocellular pathway defect.^{13,14}

Purpose

To date only preliminary estimates of both the temporal and spatial characteristics of ICS have been previously presented.^{3,5,12} The purpose of the present study is to further and more accurately define the temporal characteristics of ICS in the interest of more accurate diagnosis.

Methods

During a three-month period in early 1998, ICS responses were recorded on video from 30 non-strabismic/non-amblyopic subjects in a private optometric practice. The impetus for this recording was the desire to incorporate a visual demonstration of ICS at a major optometric educational meeting.¹⁵ During the routine flow of practice, patients or their agents were offered the option of participating. Those who agreed signed an appropriate waiver for video documentation. I test with vectographic targets as part of my routine analytical optometric examination.^{5,8,9} The test target for the suppression timing was the modified Borish diamond target at 40 cm.^{5,9-12} Half of the diamond blacks out with suppression. Subjects were instructed to raise a hand when one side of the diamond was “black-black enough that the underlying letters on that side of the diamond are not seen” and to lower the hand when the full diamond is seen. The patient was asked to continue until told to stop so “I can see what’s happening.” Testing continued for approximately one minute. No suggestion was made to either patient or parent as to the expected response. The patient was instructed to simply “observe” the events and “don’t try to make something hap-

pen.” The video recording was then started as inconspicuously as possible. Any report of intermittent diplopia (such as a convergence insufficiency producing intermittent exotropia at near) precluded a patient from video documentation.

At a later date, the video taped hand motions of the 30 patients were timed with a stopwatch by vision therapist H.C.B. No attempt was made to pre-select patients for taping, although either constant suppression (as in strabismus) or subjects showing a single suppression and then normal binocularity were excluded.

Subjects

A retrospective records search and evaluation was made to compare the standard optometric analytical findings of the present group of 30 suppressors to a prior group.⁵ The present group ranged in age from 6 to 43, with an average age of 16.9 years. The prior group averaged 10.3 years. The older average age might be expected to promote accuracy in the suppression reporting. As with the former group, this group complained about reading. All but three (90%) had (or parents expressed) a specific reading complaint, ranging from discomfort to classic “dyslexic” reading complaints such as reversals. Some patients had multiple complaints. The three who did not have a specific reading complaint all reported distance blur. Subjective complaints are summarized in Table 1.

All subjects received my standard (vectographic) optometric evaluation and were able to respond in the above-described manner for video documentation. There was no significant ocular pathology in the group. Two subjects had positive histories of whiplash cervical trauma. Best corrected acuities averaged better than 20/25 OD/OS, and ranged from

Table 1. Subjective complaints of ICS patients.

Reading Complaint	Frequency of Complaint	Other Subjective Complaints n=1
Re-reads	10	Words move Skips words Blur while reading Odd head position Headaches with T.V. Dislikes reading Can't skim text
Losing place while reading	9	
Reversals or mixing up letters and words	7	
Dyslexia/general problems reading to learn	5	
Words different when re-reads	2	
Headaches while reading	2	
Eyes “hurt” during reading	2	
No Reading Complaint... distance blur	3	

20/20 to 20/30. Monocular acuities in each subject were within one line of each other, fitting the requirement that this is a non-amblyopic group. By definition this was a non-strabismic group. Cover testing data showed exophorias of less than 1/2°, distance and near.

Other binocular alignment testing also indicates findings within the expected ranges. Associated phoria (fixation disparity target) was also less than 1/2° base-in at distance. Von Graefe near dissociated phoria through the binocular crossed-cylinder lens at near (OEP #15B through #14B lens) was 5.6 exo, essentially the same as the Skeffington/OEP expected phoria at near,¹⁶ and within probable error of the Pratt/Haynes/PUCO expected.¹⁷ Phoropter convergence and divergence testing at near with rotary prisms indicated basically normal group findings.

Average refractive error was -0.4 D.S. If refractive errors greater than 2.00D from the mean are excluded, average refractive errors become -0.08 D.S. OD, -0.06 D.S. OS, identical to the -0.08D average spherical equivalent of the 1990 group.⁵

I previously reported that only 12% of that group of ICS patients showed reduced stereopsis on the Titmus Wirt dot test.⁵ Consequently, routine stereopsis testing has become less important in my practice, leading to some inconsistency in this particular testing in my private practice. Even so, 17 of the present 30 ICS patients had scores for either the Titmus Wirt test at near, or the distance vectographic chart stereopsis circles recorded. Fifteen received the distance test, six the Wirt test, with an overlapping four patients receiving both tests. Out of this group of 17 patients receiving any stereopsis tests, three patients (18%) scored less than optimal on any test. While this is a small sample, 18% is certainly of the same order of magnitude as the previously reported 12% yield with Titmus Wirt stereopsis testing in ICS. Further research should explore whether multiple stereopsis tests or whether a superior test would improve yield significantly and make stereopsis more predictive of ICS.

Results

A total of 365 suppressions were timed in the 30 ICS patients during timing periods averaging 72.5 seconds. Twenty-four of the 30 patients (80%) alternated which

is similar to the prior report which showed 90% alternators.⁵ The right image tended to be suppressed more than the left: 222 right suppressions were timed versus 143 left suppressions; a ratio of 1.6 to 1.

The previous estimate suggested a typical intermittent central suppression to be 2 to 5 seconds long and occur at least twice within a 10-second period.⁵ The results of the present video timing are seen in Table 2. Individual timed ICS suppressions ranged from 0.2 to 16 seconds. On average, right suppressions were 2.6 +/- 2.5 seconds, left were 3.0 +/- 2.8 seconds. Simultaneous sight (binocular) periods averaged 3.4 +/- 4.4 seconds. A typical, and clinically significant, ICS suppression, then, might range from under a second to over five seconds. Since ICS is a repetitive suppression condition, these suppression periods can be expected to be spaced by periods of simultaneous sight. The typical binocular period after resolution of a suppression ranged from a direct alternation (0 seconds of simultaneous sight) to 7.8 seconds. The large standard deviation of the binocular periods might reflect that in some ICS patients, suppressions can run in "spurts." Fifty incidents of direct alternation were evident in 13 patients—essentially a zero second "binocular" period. The video also showed that some monocular suppression periods consists of repetitive same side ICS suppressions spaced by only momentary binocular periods.

To explore whether there may be a developmental trend in the length of the suppressions, I divided the group in halves by age. The younger half ranged in age from 7 to 14 years with a median age of 9 years (average 9.5 +/- 2.2 years); the older half had a median age of 18, but an average age of 24 years (standard deviation 11 years) reflecting the broader range in age in the older group of 14 to 43 years. The younger half of this ICS group averaged suppressions of 3.1 +/- 2.9 seconds right, 3.6 +/- 3.2 seconds left, while the older half averaged 1.8 +/- 1.3 and 2.0 +/- 1.5 seconds respectively (Table 2).

Another finding clearly visible in the video documentation cannot be explained with our traditional understanding of suppression: Some patients signaled that both sides of the diamond target were simultaneously suppressed. Just less than 10% of the 365 suppressions timed showed this bilateral response; i.e., both hands are

Table 2. Average length of suppression periods in ICS.

ICS Suppression Length (sec)				
Overall	R	2.6 +/- 2.5	L	3.0 +/- 2.8
Younger Half	I	3.1 +/- 2.9	E	3.6 +/- 3.2
Older Half	G	1.8 +/- 1.3	T	2.0 +/- 1.5

raised simultaneously, without diplopia. Thirteen patients showed this response, four of whom are adults. Adults showing this response suggests this is not merely a child examination phenomenon. Our conventional wisdom on suppression is based on strabismic/amblyopic cortical competitive inhibition.¹⁴ This view suggests inputs from the two sides "fight or fuse" at the cortex. Obviously, a bilateral suppression is a problem for this view, suggesting some need to modify the conventional wisdom.^{13,14}

Discussion

The method of data collection and timing deserves some criticism. Although clinically the hand raising to identify suppression periods is valuable as an ICS demonstration for parents or other observers and is easily documentable on video, some timing inaccuracy might be expected from hand movements that are faltering, slow, or imprecise. This same criticism, of course, could be made of other clinical tests. The next step to more accurately determine the temporal characteristics would be the development of a test using known ICS patients who are trained to use a subject-actuated timer. Until such a demonstration, these data stand as the most accurate to date.

The present findings are in basic agreement with the prior estimate of a typical ICS being 2 to 5 seconds.⁵ My experience indicates that any repetitive ICS occurring within a 10-second period in a non-strabismic/non-amblyopic patient is clinically significant. Matching the clinical finding with symptoms is, of course, always important.

The length of the typical ICS can range up to almost seven seconds with children. This raises the issue of how to interpret even longer suppression periods. Virtually all significantly longer suppressions in our study (e.g., one suppression period was timed at 16 seconds) were not repetitive. So, if a patient signaled a significantly longer than typical suppression,

the following suppressions signaled by that patient were usually of shorter periods. And the length of these following suppressions fell closer to the "typical" 2 to 5 seconds-long suppressions. The present results indicate that the older ICS subjects tended to have shorter suppressions. Perhaps, then, these longer suppressions indicate some sort of developmental or embeddedness level. The examiner would have to determine if repetitive lengthy suppressions were actually some aberration of strabismic suppression rather than ICS. The differential diagnosis would logically include finding periods of simultaneous central sight, and ruling out strabismus, amblyopia, and the willful control over alternation that is sometimes exhibited by strabismics.

The suggestion that ICS is an afferent visual sensory defect that affects reading and can be diagnosed by a routine (albeit non-standard) optometric evaluation has some implications. The basic optometric findings indicate that the present group is unremarkable; that is, ocularly and visually "normal" as was the 1990 ICS group. This remains an important point in evaluating the literature on reading and/or "dyslexia" and vision. Visually "normal" patients can display the sensory defect in intermittent central suppression, a defect that can negatively affect reading, and that I've suggested is visual dyslexia itself.⁵ Thus, the individual with normal ocular health, refractive, and oculo-motor findings might still have a reading problem that is at the most, visually based or, at the least, visually related. Similarly, visual perceptual testing may need reconsideration: Is the aberrant perceptual test response a consequence of this afferent defect? That is, is this response indicative of a cortical perceptual problem, or is it at least in part a manifestation of the afferent sensory defect that ICS is and therefore pre-cortical? This determination has bearing both on diagnosis and on programming appropriate therapy. Obviously, treating a pre-cortical sensory defect with traditional perception training might be less efficient than first treating the afferent sensory defect and then re-evaluating perception.

Conclusions

Data have been presented improving our understanding of the temporal characteristics of ICS. This condition is a repeti-

tive, involuntary, temporary suspension of the central field of vision in non-strabismic/non-amblyopic individuals. Routine testing with vectographic refraction can find ICS, but standard strabismus/amblyopia tests often miss diagnosing ICS. The literature that respects the above definition suggests ICS is a potentially confusion-producing sensory defect that affects reading performance.^{3,4,8,10,11}

This present subject group matches well with the previous sample in its visual characteristics. Essentially, this is a group that shows minimal refractive errors and would pass most vision screenings and routine refractions. And yet, this group - as the previous group - complains about reading problems. Their complaints might be said to be "symptoms of dyslexia". The diagnosis of intermittent central suppression, then, may be the clinical diagnosis of visual dyslexia.¹³

In sum this suggests ICS is an afferent sensory defect in vision that would logically be expected to interfere with central visual tasks such as reading. I have theorized ICS as an afferent neurological defect in visual sensation. Reading complaints appear to be associated with this visual defect. Clinically, any non-constant, non-strabismic repetitive suppression of the central field fitting the temporal characteristics in the present study's results should be considered suspect and treatment should be offered. As the only documented treatment, active anti-suppression vision therapy must be considered the standard of care and, in accordance with the established principles of medical care, be classified as medically necessary and appropriate.

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