

# A PILOT STUDY ON THE GEOGRAPHICALLY REMOTE TREATMENT OF INTERMITTENT CENTRAL SUPPRESSION USING ELECTRONIC RAPID ALTERNATE OCCLUSION

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## Abstract

*Intermittent central suppression (ICS) is a repetitive loss of sensation in central vision that occurs in the absence of strabismus and amblyopia. We used electronic rapid alternate occlusion to treat the ICS of 10 students enrolled in a Job Corp's residential educational program. The location of the program is remote from my office. We performed vectographic examinations on each student to diagnose and classify the ICS. The students also completed a College of Optometrists Quality of Life Questionnaire (QOL) before and after the therapy. The group's average lessening of frequency of ICS was 76%. The QOL scores tended to improve with the improvement in ICS. The students' and their teachers' subjective responses gave evidence that there were positive changes in reading and performance after the therapy.*

## Key Words

*COVD Quality of Life Questionnaire (QOL), dyslexia, electronic rapid alternate occlusion, intermittent central suppression, Job Corps, Magnocellular, Parvocellular, stereopsis, visual dyslexia,*

## INTRODUCTION

Intermittent central suppression (ICS) is a sensory defect that is defined as a repetitive loss of visual sensation in the central area of sight.<sup>1-3</sup> Some studies have linked ICS to reading problems.<sup>2,4</sup> I've gone further than simply suggesting a link to reading problems, by proposing that ICS is a cause of visual confusion that can then cause reading problems.<sup>5</sup> Based on one view of the neurology of dyslexia and vision, I've further suggested that this ICS-caused visual confusion might be termed "visual dyslexia," i.e., reading dysfunctions that have a visual component.<sup>1,3,6</sup>

I propose that reading problems, visual dyslexia and, by extension, ICS can affect various aspects of one's economic advancement and the health advantages that follow. Maples has suggested reading problems negatively affect quality of life.<sup>7</sup> Similarly, Eden proposed that adult dyslexics are prone to experience significant financial and emotional consequences from the dyslexia.<sup>8</sup> I have previously suggested that ICS is a defect in visual neurology that negatively affects reading performance, but that this defect is amenable to various forms of optometric vision therapy (VT).<sup>4,9,10</sup>

## Intermittent Central Suppression

Typical ICS suppressions combine a two- or three-second period of loss of sensation in the central visual area with periods of bilateral sight.<sup>2,3,6</sup> The same mechanism that fills in the void of the optic nerve

head's blind spot may fill in the suppressed area in ICS (and possibly in strabismic/amblyopic suppressions) so that a positive scotoma isn't evident.<sup>11</sup> The picture "drops out" rather than appearing as a black spot in central vision. After a two or three-second absence, the suppressed eye's central picture returns. However, during the suppression period, the visual feedback for accurate oculomotor aim is absent centrally, creating inaccuracy.<sup>2,6</sup> During the suppression period, the suppressed eye is free to drift slightly off target. When the formerly suppressed eye's picture returns, any aiming error must be corrected. Realignment is necessary to eliminate the aiming error and reduce any visual confusion that resulted from the misalignment. The aim correction requires a non-saccadic vergence movement to realign, confusing the visual image further with motion.<sup>6</sup> Since ICS is repetitive as well as alternating, in 80 to 90% of ICS patients, just as the alignment is reestablished, the whole series repeats: suppression, misalignment, visual confusion, motion and realignment. I therefore propose ICS produces visual instability and, through that visual instability and confusion produces "visual dyslexia." An individual with ICS contends with a constantly changing visual world, due to suppression, in the central, most precise area of sight.<sup>5,6</sup>

It is possible that suppression is an exclusively cortical phenomenon. However, I have suggested Magnocellular (M) defects through the mechanism of Troxler's perceptual fading would better explain

what we clinically observe in ICS than it being cortically based.<sup>6</sup> In either view, it is a neurological defect, not some sort of “muscle problem.” If we assume that ICS is a function of a M defect, then the likely location of the problem is at or near the Lateral Geniculate Nucleus (LGN).<sup>1,5,6</sup> Therefore, ICS is an *afferent* neurological defect and likely to affect visual processing at all higher visual areas. That also means that a decrease in ICS should cause a decrease in the theorized visual confusion. Any decrease in the visual confusion that might be a partial cause of poor reading behavior, should improve reading performance.

The M defect theory helps explain the intermittency and the limitation of the suppression to the central area of sight. M cells are most densely massed centrally.<sup>12,13</sup> Therefore, if the suppression is at least a partial function of M deficiency, that deficiency will primarily be expressed in the central area of vision. Also, if ICS is a consequence of M defect or deficiency, then properly administered motion stimuli should strengthen the M-pathway synapses and thereby reduce the suppression.<sup>10</sup>

As ICS is eliminated with vision therapy (VT), and with consequent normalization of visual sensation, we might expect other functions to also change. For example, convergence changes have been reported apparently secondary to the improved sensation even without specific convergence therapy.<sup>10</sup>

Thus, it follows that we might be able to test for changes in reading symptoms with changes in ICS. Further, if we isolate ICS therapy from other visual therapies, there is some degree of certainty that we are primarily, if not entirely, treating the suppression without treating other visual functions, such as eye movements or convergence.

The goal of the following pilot study was to evaluate an anti-ICS protocol. This was to be conducted without the involvement of trained personnel and other VT procedures, in a location geographically remote from the author’s office.

## SUBJECTS

Thirty-seven students residing at a Job Corps site in Curlew, north central Washington State comprised the initial pool. They were enrolled in a program serving young adults who did not graduate from high school. The purpose of this residential educational program is for the stu-

dents to obtain job skills and a graduate equivalency diploma (GED). Teachers at the site had identified all subjects as being reading disabled. The subjects’ ages ranged from 16 to 23 with an average age of 19.6 years. Ten of these students with an average age of 20.6 years (none under 18 years of age) agreed to take part in the study. Nine males and one female participated.

## PROCEDURES

All members of the initial pool of subjects received an optometric evaluation at my office. This included evaluations of ocular health, distant and near visual acuities, oculomotor status, refractive status and accommodation/convergence status. Eye movements were assessed by the Developmental Eye Movement or King Devick Test,<sup>a</sup> and near stereopsis by the Titmus Test.<sup>b</sup>

I additionally performed the vectographic binocular refraction examination procedure I have previously described.<sup>14</sup> This procedure uses the projected American Optical (AO) distance vectographic chart,<sup>c</sup> combined with the Modified Borish Near card (MBT) for nearpoint testing.<sup>15,16,c</sup> When an individual gave a typical ICS response on the vectographic targets, I explained the nature and effects of the suppression and recommended therapy using electronic rapid alternate occlusion to be carried out at the Job Corps site in Curlew. I typically quantify the suppression as much as possible at this initial examination specifically to compare ICS responses pre- to post-therapy. That quantification includes both timing the on-off suppression sequence on at least one vectographic target over a period of 20 to 60 seconds. I also record the particular vectographic targets where the patient reports ICS responses. All subjects completed a College of Optometrists in Vision Development (COVD) Questionnaire (QOL).<sup>17</sup>

## RESULTS

### Initial Optometric Evaluation-Total Pool

In this pool of 37 students all but one showed ICS. The average score of the full group on the QOL was 39. Maples has proposed that a score of 20 on the questionnaire should raise suspicions and that a score of 25 is an absolute indicator for examination for vision problems affecting learning.<sup>17,18</sup>

The most frequently reported QOL items were: memory and attention problems,

trouble completing assignments on time, skipping and repeating lines when reading, not using time well, losing things, poor handwriting and hand-eye coordination, writing uphill and downhill, and generally avoiding near work.

Twenty-seven students showed lower than adult level scores on one standardized eye movement test. Nine were diagnosed with convergence insufficiency.

Twenty-four of the original 36 (67%) who were diagnosed with ICS were unable to report stereopsis at the 40 arcsecond disparity level (target #9) on the Titmus Stereotest. Seventeen of the same 36 suppressors failed to recognize 50 arcseconds of disparity (target #8). At distance two obtained less than the maximum score of 4 (60 seconds). That is, a maximum of two-thirds of this group specifically diagnosed with ICS would be identified by the Titmus Stereotest as failing and therefore as having a suppression. None of this group had ocular health problems.

### Initial Optometric Evaluation-Treatment Group

Ten individuals agreed to participate in the study. The average age of these nine males and one female was 20.6 years. All had corrected visual acuities at distance and near of a least 20/30 in each eye, with no more than one Snellen line difference between the two eyes. They were further screened for history of seizures. They signed a waiver, which explained the treatment, and characterized it as experimental.

Refractive status for the group agreed closely with previous ICS groups.<sup>2,3</sup> Nine of the 10 students in the treatment group averaged -0.2 +/- 0.8 D spherical equivalent. One student was significantly myopic: OD -7.87, OS -9.37 diopter spherical equivalents. Six (60%) failed to correctly recognize 40 arcseconds of stereopsis on the Titmus Stereotest (Target #9). Six of the 10 tested below adult levels on one of the standardized eye movement tests. Initial QOL scores ranged from 13 to 81 (avg. 48, s.d. 23). Three were diagnosed with convergence insufficiency and half with accommodative insufficiency.

### PROCEDURE Treatment Group

These 10 subjects were re-evaluated with the same vectographic examination routine for suppression after treatment, an average 4.9 months after the initial exam-

ination. Re-testing with a full optometric analytical evaluation also allowed the evaluation of vision finding changes such as convergence and accommodation. They also completed a new QOL questionnaire. The QOL questionnaire has shown acceptable test-retest reliability.<sup>17</sup> We classified each subject's ICS according to a system developed by Zeri et al.<sup>16</sup> As seen in Table 1, the scale ranged from no suppression (S0) to constant monocular suppression (S5). They evaluated a similarly aged group of proficient readers, average age 23.5 years.

## METHODS

### Treatment Group

We provided each of these students with a pair of the alternating liquid crystal goggles to be used onsite in Curlew. We provided our instructions with some teacher supervision, but without our direct, daily oversight. Subjects were instructed to read text of their choice while looking through the goggles for a maximum of 40 minutes at least three times weekly. Any negative symptoms were to be reported immediately.

The device itself consists of an electrically driven, electronically controlled pair of liquid crystal goggles which provided alternate occlusion of vision (for this group) at 5 Hz.<sup>d</sup> This is a different alternation frequency than, for example, Allen's Translid Binocular Interaction Trainer's (TBI Trainer) 9 to 11 Hz alternation rate.<sup>19-21</sup> We used the 5 Hz treatment alternation frequency that we have determined to be an effective alternation rate in treating ICS. The rate is based on a frequency bracketing technique while the patient views a central target in a cheiroscope: The ICS patient reports changes in the suppression with changes in alternation frequency.<sup>9,10,15</sup> Although electronic rapid alternate occlusion is relatively new, having documentation from 1995,<sup>9</sup> Allen noted that flash techniques have been used by optometrists for "at least 65 years."<sup>21</sup> Electronic rapid alternate occlusion delivers a bilateral motion stimulus. That is, on-off flicker is motion in stimulus form.<sup>22</sup> The alternation at about 5 Hz is fast enough that the signal is perceived in the central vision as a continuous and simultaneous signal. The subject is effectively (and paradoxically) "binocular" in the central vision.

**Table 1: Classification of types of suppressions<sup>16</sup>**

S0=	no reported suppressions (binocular fusion).
S1=	no more than 2 very short disappearances of one or more than one letter.
S2=	frequent intermittent suppression ( $\geq 3$ times) of one letter, more than one letter or the entire monocular stimulus. Suppressions did not occur in regular cycles, and could be alternating or monocular.
S3=	frequent intermittent suppression ( $\geq 3$ times) of one letter, more than one letter or entire monocular stimulus. Suppressions occurred in regular cycles and could be alternating or monocular.
S4 =	regular cycles of intermittent suppression of entire monocular stimulus. Monocular suppression lasted about 2-3 seconds followed by binocular fusion for 2-3 seconds, and then, the previously dominant eye was suppressed for 2-3 seconds, as in Hussey's description of ICS.
S5 =	constant monocular suppression of one eye (clinical suppression).
D=	Diplopia.

## RESULTS

### Treatment Group ICS

The ICS of the 10 subjects improved. All subjects initially were classified as S4. See Table 1. The average suppression period during the ICS cycle was just under 3 seconds; the average "binocular" period was just over 3 seconds. However, two of the 10 found the changing sensation too disorienting to accurately report the suppression cycle at the initial exam. Eight of the 10 alternated, agreeing with prior reports of 80 to 90% of ICS patients having an alternating intermittent suppression.<sup>2,3</sup> One of the two other students repeatedly and unilaterally suppressed the right eye's central vision, the other repeatedly suppressed only the left eye's central vision.

The group's lessening of ICS time was estimated to range from 20% to elimination of ICS (100% improvement). The group's average improvement changed from the initial S4 classification to S2. See Table 1. Two of the 10 were still classified as S4. One improved to no reported suppressions (S0 on Table 1).

### QOL

Nine of the subject's QOL scores improved. The post-therapy QOL scores decreased and clustered more tightly than pre-therapy scores. Post-therapy QOLs averaged 30.5 (standard deviation of 15.7), down from an initial average of 48. The post-therapy difference in scores that decreased ranged from a low of 3 (7.1% decrease) to a high of 54 (66.7% decrease).

### Stereopsis and Eye Movement Testing

Four of the six who originally showed a lowered stereopsis measurement increased their scores to the maximum of nine correct (40 arcseconds) post-therapy. Post-therapy standardized eye movement testing was unreliable. Motivation played a role. One student refused the post-therapy test (DEM).

### Accommodation/convergence

Other analytical data changes from pre- and post-therapy vision examinations were equivocal. No general trend was evident in accommodative or convergence findings.

### Post-therapy Subjective Comments

DL: "Reading textbooks is a lot better"  
 JR (1st "JR"): "Words are not blurring or jumping". Also, a teacher reported his reading score jumped from 6.2 to 8.9 in three months.

MW: "Not losing my place as much, writing skills have improved, no more double vision". A teacher reports "his vision has really changed. He [MW] described it as seeing the written words as if they were on a piece of crumpled material that has slowly been spread out and straightened."  
 CC: "I read a whole book for the first time in my life - *Stuck in Neutral*." [Note - *Stuck in Neutral* is written on a Junior High reading level.]

JR (2nd "JR"): Reading is easier. Prior to therapy his depth perception would "just go out." That doesn't happen now. Teachers "are amazed. I'm their miracle kid. I'm not a very fast reader, but things have really improved...oh man!" It has made

a “huge difference in trade [bricklaying]. Awesome.” Note - prior to therapy this JR had trouble with aligning bricks. His instructor commented on the difference post-therapy.

BS: Never used to read and is now reading Jack London novels. His teacher reports the therapy “changed his life”. He is now reading avidly, “devouring” books. He got a job as a welder. Note - BS was one of the students reporting side effects: headaches and achy eyes that disappeared after two months of goggle use.

MT: Reading is “coming along greatly” and is reading faster. Comprehension is improving.

GP: Not losing his place as much when reading.

CS (who didn’t improve on the QOL checklist): When he arrived at Job Corps his reading level was 2.8. It improved to 8.8. During the month of April 2005 it improved from 7.7 to the 8.8 level. His comment on 1/31/05: “I was at the second grade reading level for years. Now it’s at the 10th grade level. The goggles sure worked for me.” See Appendix for article published in *Job Corps Times*.

## DISCUSSION

These data indicate that ICS lessened with the provided therapy in a non-clinical remote setting and a less than optimally motivated group of subjects. Further, these data suggest that when ICS was reduced or eliminated, symptoms as measured by the QOL scores tended to improve. Those improvements were accompanied by positive comments from patients.

The Zeri et al’s classification system<sup>16</sup> proved to be a useful and effective device in specifying the treatment group’s ICS. It showed a reduction in both the frequency and duration of ICS.

Post-therapy subjective comments suggest more improvement than the QOL scores indicated. Vaughn, et al showed a lowering of correlations between student-reported symptoms with the QOL and academic performance after third grade.<sup>23</sup> These findings might indicate that in projects such as the present study, teacher’s observations or teacher reported QOLs could be a more accurate measurement than subject reported QOLs.

The students with ICS who did not elect treatment could have provided a control group for this study. However, none of these individuals responded to our request to obtain a post-Job Corps program QOL. A traditional control group was not avail-

able. However, it might be argued that if a successful educational treatment or a placebo were available, it would have been instituted previously. Therefore, it is reasonable to propose that the treatment group served as its own control: Any improvement could then be assumed to be at least in some part a function of the treatment. Further, since these students were adults, changes in behavior can be interpreted as treatment effects rather than natural neurological development during the span of treatment.<sup>8</sup> This view would be supported by the comment of one of the treatment group that he “was at the second grade reading level for years.” (He is now at the 10th grade reading level.)

Remedial education was carried out during the course of the ICS therapy. Thus, the reported changes in reading performance could be from the remedial education, from both the educational program and the ICS therapy, or from the education assisted by a placebo effect from the therapy. In contrast, changes in the ICS, as measured post therapy cannot logically be explained by the placebo effect of the reading instruction, and can be assumed to be only from the therapy. The available data suggest ICS does not typically correct without treatment.<sup>2</sup>

The lack of other significant changes in accommodation/convergence findings suggests that reduction or elimination of the suppression does not negate the need for treating other deficient areas of vision. Further, this lack of change in accommodation/convergence findings supports the premise that we have in fact treated the ICS in isolation with electronic rapid alternate occlusion.

Our results on stereopsis continue to show a curious relationship between stereopsis testing and ICS. Previously presented data did not support the Titmus test as a reliable diagnostic test for ICS.<sup>2,3,15</sup> Some 67% in our initial pool of 36 subjects with ICS would have been diagnosed as suppressing on the Titmus test. A similar percentage failed in the treatment group (60%). These numbers are strikingly different than previous reports of 12%<sup>2</sup> and 18%<sup>15</sup> yield for the Titmus test in diagnosing ICS. This raises the question of how a suppression can coexist with normal stereopsis in 33% to 40% of suppressors? A possible answer is that the Titmus test is not adequately sensitive. But, this exception gives support to the notion that stereopsis and ICS are not linked in the same way that strabismic/amblyopic suppres-

sion and stereopsis are linked.<sup>24</sup> Zeri et al have stated they will be researching ICS and stereoacuity, hopefully giving further insight.<sup>16</sup>

## CONCLUSIONS

A larger, controlled study is necessary to assess the efficacy of the treatment for ICS that was used in the present study. But, the experience with our subjects suggests several things: First, ICS is treatable with electronic rapid alternate occlusion. Since electronic rapid alternate occlusion delivers a strong bilateral motion stimulus, this may support the theory that the locus of neurological change is in the M pathway.<sup>6</sup> Further, this therapy can be conducted away from the clinic with reduced professional oversight and little if any risk to the patient.

Reduction of the ICS generally improved patients’ assessment of their reading symptoms as measured with the QOL, or as reflected in student comments. The lowered QOL scores might reflect better academic performance. In a larger study, more objective reading testing or grading would be preferable.

Reduction of the ICS did not automatically remove the need for further conventional VT for accompanying binocular and/or accommodative problems. I propose the most efficient way to treat binocular problems should be to first eliminate ICS when present, and then address the other vision deficiencies.

*Dr. Hussey is the primary inventor of the rapid alternate occlusion goggles. No commercial version is yet available. Clinical studies continue.*

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## Appendix

### Job Corps Student Sees New Future

Imagine going to school for eleven years not being able to read; worrying that peers would find out your secret, feeling you were different from others, thinking that you just weren't as smart, dodging requests to read out loud, fighting a losing battle to keep up with your classmates, and knowing it was just a matter of time before you couldn't fake it any longer. If you can relate to these challenges, then you know how Charles Stewart of Pocatello, Idaho felt as he made his way through public school.

Charles came to Curlew Job Corps in May of 2004, at the age of twenty. His initial reading tests revealed that he could read at a second grade level.

In November of 2004, Stewart was seen by Dr. Eric Hussey, O.D., FCOVD, in Spokane, Washington. Dr. Hussey is doing research on the use of prototype vision goggles that use flashing light to correct a type of vision impairment called intermittent suppression. Intermittent central suppression occurs when either eye repetitively "shuts off" its picture for a few seconds. During the suppression period, the suppressed eye can wander slightly off target. Then, when its picture returns, visual confusion will result until the formerly suppressed eye can regain its aim, only to have the problem repeat in a few more seconds. The visual world with suppression is unstable and confused. "I had to read things over and over and I still couldn't understand what I was reading," Charles lamented.

Charles was diagnosed with intermittent central suppression. Shortly after, Charles began using the vision goggles. "I began by reading 30-45 minutes every other day. I read simple books like Dr. Seuss. At first I felt kind of dizzy from the strobe lights."

It took about a month to see results. "I couldn't stop reading!" Stewart said excitedly and added, "I have been reading a lot of history books like Blackhawk Down and Uncle Sam's Boy about WWI. I never thought I'd look forward to reading!"

Charles' last reading test shows marked improvement. Now reading at nearly a ninth grade level (8.8 on a Test of Adult Basic Education) Charles and his family are proud of his efforts. "It's changed me. I can see myself being successful now." Stewart stated. "It was scary to think of a future without being able to read."

Charles plans to join the Army to get further skills after he gets his G.E.D. and finishes the Brotherhood of Carpenters and Joiners Pre-Apprenticeship program at Curlew Job Corps. He hopes to someday be a general contractor.

Charles' story is not unique to the Center. Over a dozen participants have improved their reading, due in a large part to Dr. Hussey's vision therapy.

Charles was anxious to tell his story. He ended our interview by saying, "Who knows, maybe I might even try going to college."

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