

Article ▶ Severe Convergence Insufficiency/Intermittent Exotropia: A Case Report

Richard C. Laudon, OD, New England College of Optometry, Boston, Massachusetts

ABSTRACT

Background: Although convergence insufficiency is a common diagnosis, a diagnosis does not always define the degree of the dysfunction. There are many other variables, from the patient's symptoms to the actual binocular deviation to other visual and non-visual factors. Convergence insufficiency is rarely the only condition that needs to be treated. It is important to note that numbers are simply guideposts since they can change over time and even over the course of a day. In focusing on the type of optometric vision therapy that was designed and implemented, a combination of office-based and home-based interventions can be effective in many cases. The long-term effectiveness of therapy is also illustrated in this specific case.

Case Report: The patient, Molly, a 7-year, 10-month-old female, was seen at our Pediatric/Binocular Vision Clinic at the New England College of Optometry with significant symptoms and a severe convergence insufficiency. In a teaching clinic, students are the primary therapists despite their limited vision therapy experience. For this reason, procedures and sequencing of therapy may be different than in other clinical settings. Despite our initial concerns, Molly showed incredible improvement from her first exam and has maintained those gains for over two years. Two key procedures that were implemented in her therapy are highlighted. Molly's case is an example of how vision therapy can improve a patient's quality of life.

Conclusion: Convergence insufficiency can be treated effectively by an in-office/home-based program. The repetition of appropriate optometric vision therapy procedures at home will help resolve a patient's maladaptive visual condition over time.

Keywords: accommodative dysfunction, convergence insufficiency, diplopia, look away and relaxation technique, maintenance therapy, near point of convergence (NPC), plus/plus flippers, visual hygiene

Case History

Molly, a 7-year, 10-month-old female, was seen for a comprehensive binocular evaluation. She complained of double vision, blurred vision, and loss of place. Molly was referred by an optometrist because of an eye teaming problem. Her school performance was good, with the exception of math. The patient's medical history and systems review were unremarkable. Developmental milestones were within normal limits.

Examination Findings

Table 1 shows the visual evaluation findings.

Diagnoses

- 1) Simple hyperopia – OU
- 2) Intermittent exotropia (convergence insufficiency pattern)
- 3) Accommodative dysfunction
- 4) Ocular motor dysfunction

Treatment

At the conclusion of her exam, we had a conference with Molly and her parents. We outlined our concerns, which included the severity of her symptoms and the degree of her misalignment. In Molly's case, we also discussed our options,

Table 1. Visual Evaluation Findings

VA Dist and Near	20/20 OD, OS, and OU
Harmon's Distance	13"
Reading Distance	8"
Cover Test Dist Near	16 exophoria 30 exophoria (which lapsed into an exotropia)
NPC Penlight Red Glass	8"/11" Diplopia
Color Vision	Normal OD and OS
Stereo	25 secs at near (Randot stereo)
DEM	56 vertical, unable to complete horizontal sequence
Accommodative Facility	Failed + and - 2.00 OD, OS, and OU
Static/Subjective	+0.75 OD, OS, and OU with 20/20 acuity
Phoropter Testing	unable to assess any testing due to diplopia
Eye Health	WNL – OU

from monitoring to optometric vision therapy to surgery. The latter was included so that the parents understood all of their alternatives. We also asked Molly whether she was or was not interested in doing therapy. Without a motivated patient, optometric vision therapy is programmed for failure. One final recommendation was to stress the importance of proper

Table 2. Progress Evaluation Findings

VA Dist and Near	20/20 OD, OS, and OU (slight degree of hyperopia (+0.75))
Cover Test Dist Near	20 exophoria 25 exophoria
NPC Penlight Red Glass	4"/8" 7"/10"
Accommodative Facility	Passed OD, OS, and OU
Stereo	20 secs at near (Randot stereo)
DEM	48 vertical, 54 horizontal
Lateral Phoria	20 exophoria at both distance and near
Ductions	Distance BI 29/13 BO X/17/-6 Near BI 31/15 BO X/20/7
Fused Cross Cylinder	+0.75 +1.00 19 exo
NRA/PRA	+3.00/-1.75

visual hygiene, which included maintaining proper posture (Harmon's distance) and strategic breaks.

Although convergence insufficiency is typically improved by optometric vision therapy, the magnitude of Molly's deviation was certainly a major issue. We also had to deal with travel issues because she did not live in the metropolitan area. Despite these concerns, her parents were enthusiastic about pursuing vision therapy.

An in-office/home-based program was designed and implemented to improve Molly's skills after her initial exam. Our typical regimen includes three to four techniques, which are taught to the patient at the Clinic and then programmed for home therapy. Since our therapists are fourth year students, who rotate through the Clinic on a three-month basis for approximately 2 to 3 days per week, the number of techniques is limited to maintain consistency between the different students. The patient/parent has an unwritten contract to do a minimum of twenty to thirty minutes per day for at least five days per week. They are then seen on a bi-monthly basis for six sessions. The last session is always a progress evaluation. We expect improvement in the patient's symptoms and skills within four to six weeks.

Our clinical approach is initially to stress monocular skills and to integrate binocular skills at the appropriate time. On Molly's first session, we focused only on a monocular skills-based program. Her treatment plan included circling Es or Os, with the emphasis on the former. We also used +/- flipper accommodative rock with reading. In this procedure, the patient reads a paragraph and then flips the lenses. It is important for the patient to reorient their posture after each flip (Appendix A). Saccadic workbook 2 was also part of her home therapy. The total home training program was approximately 25 minutes per day, with Saturday and Sunday as the key days. Weekends allow the patient to do their therapy in the morning versus evening without the stresses of school or work.

Molly returned three weeks later for her second visit. She reported that the activities were helping, and she was

Table 3. Three-Month Progress Evaluation Findings

VA Dist and Near	20/20 OD, OS and OU (slight degree of hyperopia (+0.75))
Cover Test Dist Near	20 exophoria 25 exophoria
NPC Penlight Red Glass	Nose 4"/10"
Accommodative facility	Passed OD, OS and OU
Stereo	16 secs at near (Randot stereo)
DEM	52 vertical, 55 horizontal
Lateral Phoria	7 exophoria at both distance and near
Ductions	Distance BI 16/6 BO X/12/8 Near BI 20/6 BO 20/24/10
NRA/PRA	+2.50/-1.50

less fatigued. The goal of each follow-up session is to reassess the patient's performance and assess the difficulty of their program. Molly was able to switch from the +0.50/+1.00 flipper to a +0.75/+1.25 flipper. We were also able to integrate the Brock string into her program. The circling Es and saccadic workbook were continued for another three weeks. The key changes were a decrease in her symptoms and an increase in her skills.

On her third session, Molly reported that she was doing well and had noticed a definite decrease in her diplopia. She was able to do her therapy techniques with better speed and accuracy. At this visit, we were able to integrate a clown tranaglyph into her regimen. Since we allow the patient to take the equipment home, vectograms are not an option. Molly's ranges on the clown tranaglyph were recorded as BO 22/2 and 28/2, while her BI ranges were 17/2 and 15/2. It is not uncommon to see extended ranges initially. As the patient becomes more aware of blur and diplopia, we may often see a more restricted range at the next visit. She spontaneously reported that the clown became smaller on her BO vergences. With the addition of the clown tranaglyph, we changed the circling Es or Os and saccadic workbook to alternate days. Our goal was to keep the program to a minimum of twenty to thirty minutes per day, with a break at the halfway point in each session.

By her fourth session, everyone in the family had noticed a significant difference in Molly's progress. Due to a cold, she was not feeling very well at this session. A key change at this visit was a shift from monocular to a totally binocular phase. We also discontinued the Brock string and integrated prism jumps with a six diopter prism. We typically do six to ten cycles per eye, which includes holding a near target single and clear for three seconds and repeating this sequence for both BI and BO twice per cycle. In regards to the clown tranaglyph, we changed to a plane tranaglyph. We also began to use a look away technique on BO and a relaxation technique on BI to help the patient understand the difference between converging and diverging her eyes (Appendix B).

Table 4. Post-Booster Evaluation Findings

Cover Test Dist Near	20 exophoria 20 exophoria
NPC Penlight Red Glass	4"/6" 4"/6"
Accommodative Facility	Passed OD, OS, and OU
Stereo	20 secs at near (Randot stereo)
DEM	43 vertical, 64 horizontal
Lateral Phoria	15 exophoria at distance 11 exophoria at near
Ductions	Distance BI 22/6 BO 18/25/9 Near BI 22/25/16 BO X/24/12
NRA/PRA	+2.00/-2.50

The fifth session showed some limited progress because of an illness and less consistency in her therapy. We did upgrade the prism from six to eight prism diopters and worked with both the plane and clown tranaglyphs on alternate days. We re-emphasized the importance of maintaining a five-day-a-week program. A progress evaluation was scheduled in three weeks.

Molly was seen for her progress evaluation approximately five months after beginning her therapy (Table 2). She was no longer seeing double.

At the conclusion of her exam, our clinical approach was to discuss the results of her program with Molly and her parents. In our conference, we emphasized the significant improvement in her overall visual functioning but cautioned everyone about a potential regression in the future. Although we did discontinue our formal therapy regimen, we did recommend fifteen minutes of informal therapy for three to four days per week to reinforce her previously learned skills. A progress evaluation was to be scheduled in three to six months to redefine our priorities.

Although we do not often recommend a modified maintenance program after completing three months or six sessions of formal therapy with children, we were still concerned about Molly's fragile visual system. On the other hand, most of our adult patients prefer the option of doing therapy during this interlude from their active therapy program.

A progress evaluation was conducted three months later (Table 3). Molly reported that she was doing her home therapy approximately 2 to 3 days per week. She had no diplopia or any other visual symptoms.

Although Molly was asymptomatic, we decided to pursue a booster therapy program during the summer months. We have designed this specific type of program to begin in mid-June and end on September 1. We have learned to avoid any therapy when children begin a new school year because of problems with compliance. In Molly's case, we formalized her program at the conclusion of her progress exam.

Molly was seen for a total of three visits during the summer. Her program was similar to the initial program that was detailed at the beginning of this case report. A progress evaluation at

Table 5. Six-Month Evaluation Findings

VA Dist and Near	20/20 OD, OS, and OU (slight degree of hyperopia)
Cover Test Dist Near	8 exophoria 12 exophoria
NPC Penlight Red Glass	Nose Nose
Accommodative Facility	Passed OD, OS but struggled with OU
Stereo	12.5 secs at near (Randot stereo)
Lateral Phoria	2 exophoria at distance 5 exophoria at near
Ductions	Distance BI 20/12 BO 14/24/14 Near BI 24/30/18 BO 28/31/18
NRA/PRA	+1.75/-2.00

the end of the summer showed overall improvement in her accommodative and binocular capabilities (Table 4).

Since it was the beginning of a new school year, we discontinued her entire therapy regimen. Because her parents and Molly were concerned about a potential regression in her skills, we allowed them to keep her equipment. Our clinical strategy was to re-emphasize the importance of proper visual hygiene and monitor her from a symptom perspective. A re-evaluation was suggested in January to redefine our priorities.

Molly returned to the Clinic for a progress evaluation in January. She had not done any therapy since the summer. Molly had no specific visual complaints. Her overall visual profile continued to show improvement (Table 5).

These findings were significantly different than her previous evaluations. Since Molly was no longer actively involved in her therapy program, this improvement seemed paradoxical. Since there is no simple answer to these changes, we can only speculate about the underlying reason(s). In clinical practice, it is not uncommon for a patient to see improvement post-therapy as their visual system continues to reorganize. Other factors could include the day of the exam, the time of the exam, and/or the patient's level of stress or fatigue. In view of her current status, our clinical approach was to continue to re-emphasize the importance of proper visual hygiene and to monitor her on a periodic basis. The onset of complaints would force us to reconsider our alternatives.

Molly was last seen for a comprehensive binocular vision evaluation approximately two years after we had initiated an in-office/home-based vision therapy program for her severe convergence insufficiency and/or intermittent exotropia. She was still basically asymptomatic. Her skill profile showed some regression, but her overall functioning was adequate for this point in time. Specific concerns were some instability in her phoropter findings. Her cover test has been stable with measurements of 10 exophoria at distance and 15 exophoria at near. Her NPC was to the nose with either the penlight or red lens. Molly's degree of deviation is still problematic. Despite our concerns, she has learned to compensate for her visual dysfunctions and to deal effectively with her day-to-day

visual tasks. It is important to note that findings are simply guideposts and not absolute numbers. Her findings can change dependent on many variables, as previously mentioned in her case study. Our current strategy is to continue to monitor Molly closely. It is possible that we may need to consider a booster therapy program in the future. For now, both Molly and her parents are very excited about the results of her vision therapy program.

Some Thoughts Regarding Our Therapy Program

The literature has many articles that address the topic of convergence insufficiency, from reviews to impact to the gold standard of intervention, the Convergence Insufficiency Treatment Trial (CITT).^{1,2} Textbooks and articles have also focused on this specific diagnosis, with more emphasis on characteristics than on actual treatment protocols.^{3,4}

The clinical approach to convergence insufficiency can vary depending on the doctor's model of vision and/or clinical experience. Some doctors tend to be more gross motor oriented, while other doctors are more eyeball oriented. It is important to note that convergence insufficiency is rarely simply an eye teaming problem. There can be other visual problems and other non-visual problems that are associated with any individual case. In an article by Michael P. Doyle, *Vision Therapy In Modern Behavioural Optometry Practice: The History of Vision Therapy and Contemporary Approaches to Case Selection, Case Management, and the Delivery of Treatment*, he eloquently addresses this concern in the following commentary: "Office- and home-based vision therapy have remained the general mode of delivery while also being augmented by computer- and internet-based programs. These advances have expanded the options of treatment available. Theories and implementation continue to change, as does the discussion and preference for the varied modalities of treatment."⁵

Our specific program at the New England College of Optometry, Commonwealth Practice utilizes an in-office/home-based program, which has been developed because of our unique academic situation and our patient's needs. Since

most of our patients live outside of our area, many parents/patients are resistant to driving into Boston on a weekly basis. We also see patients from states outside of Massachusetts. Our therapists, who are fourth-year students, spend three months in the Pediatric/Vision Therapy Clinic but are limited to less than two days on any specific week. For this reason, we use a selective number of training procedures since students may not see the same patient from visit to visit. In most cases, our program has been both cost effective and time efficient. It is not appropriate for all patients, but it has been very successful despite many potential obstacles.

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Correspondence regarding this article should be emailed to Richard Laudon, OD, at laudonr@neco.edu. All statements are the author's personal opinions and may not reflect the opinions of the representative organizations, ACBO or OEPE, Optometry & Visual Performance, or any institution or organization with which the author may be affiliated. Permission to use reprints of this article must be obtained from the editor. Copyright 2017 Optometric Extension Program Foundation. Online access is available at www.acbo.org.au, www.oepf.org, and www.ovpjournal.org.

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Appendix A. Plus/Plus Flipper Therapy

Purpose: Develop more accommodative flexibility by utilizing +/- flipper lenses. Plus/plus accommodative rock is a very important vision therapy technique. It can prevent a patient from over accommodating and improve a patient's plus acceptance.

Rationale: In an article, "The Use of Plus/Plus Accommodative Rock in Vision Therapy," which appeared in the Journal of Behavioral Optometry, Volume 17/2006/Number 4/Page 97, I have stated my reason for using +/- versus +/- flippers in therapy.

Procedure:

- 1) The patient will begin with a +0.50/+1.00 flipper and reading material. In a younger child, we will use nonsense letters or symbols.
- 2) The patient will read a paragraph or a line and then flip the lenses. The patient will reorient posture after each flip. It is very important that the print or symbols are always clear. We also will assess whether there is a difference between the patient's eyes.
- 3) In this scenario, we will recommend more accommodative rock therapy for the weaker of the patient's two eyes. In an ordinary case, we would typically recommend three to four minutes per eye, which is done twice during their home therapy program. Another sequence could be two minutes with the right eye, two minutes with the left eye, and two minutes with the right eye in the case of a significant difference between the patient's two eyes.
- 4) The patient's performance will be reassessed at the next visit. The goal is gradually to increase the power of the +/- flippers. We have used the following combinations: 0.50/+1.00, +0.75/+1.25, +0.75/+1.50, and +1.00/+2.00. The goal is to increase the power of the flipper at each visit. It is important that the patient's eyes are each capable of clearing these lenses in an efficient manner. We are also looking for the patient to be aware of the subtle differences between the lenses.
- 5) At the appropriate time, we will shift to binocular rock. Plus/plus flippers are very helpful in a patient with a convergence excess profile. By relaxing the accommodative system, we are able to improve the patient's divergence ability. It is possible that we may need to reduce the flipper strength when we change to the binocular phase of programming. For example, we would use a +0.50/+1.00 rather than a +0.75/+1.50 at this juncture. We also need to continue to stress the importance of clarity, single binocular vision, and posture. Binocular rock is done for a total of 12 to 14 minutes during a patient's daily home therapy program.

Appendix B. Look Away and Relaxation – Vectogram or Tranaglyph

Purpose/Rationale: Patients need to understand the feelings of converging and diverging their eyes. These techniques can be helpful in improving a patient's fusional ranges and accommodative functioning. It is very important to understand that we should not limit our intervention to only extending the patient's compensating duction or vergence range. In the final analysis, it is HOW the system is ultimately balanced that will define the success or failure of our therapy program.

- 1) The initial step in integrating a vectogram or tranaglyph into a patient's program is simply to put the patient into an appropriate therapy situation. With the proper glasses (red/green or Polaroid) on the patient, the therapist will move the target in either the base-in or base-out direction. It is important that the patient is not initially given any clues regarding any potential changes. When a patient spontaneously reports blur or double or SILO, you are more confident of your findings. In the case of the patient, who is not aware of any change, you would use the blur and/or diplopia as key terms. It is also important to monitor the suppression controls. I would avoid any mention of SILO. You should record the ranges and then develop an appropriate ratio.
- 2) A ratio is based on a patient's performance on the vectogram/tranaglyph. For example, a patient may have a similar range in either the BI or BO direction. In this case, I would use a 2:2 ratio. They would move in either direction twice. On the other hand, for the patient who has a very high BO range and a very low BI range, I would change the ratio to 1:4 (BO:BI) to emphasize the BI range of functioning. It is important to note that most patients have a greater ability to converge versus diverge their eyes. It is counterintuitive for most of us to understand the concept of relaxation. Obviously in patient care, there are exceptions to all the rules.
- 3) Look away is simply going out to blur or double; decreasing until clear and single; looking away, which breaks fusion; and then making the target single and clear again for two sequences. In the relaxation approach, the patient has the tranaglyph at zero. They will then close their eyes and relax 1 and relax 2. When they open their eyes, they then let the tranaglyph/vectogram target move into the BI direction without an effort. Any degree of effort will cause them to over focus or to over converge, which will cause diplopia and/or blur. As soon as the target becomes blurry or double, they decrease until clear and single and repeat this directional set starting again at zero. We then develop a ratio system based on the patient's demonstrated ranges.
- 4) As the patient improves their fusional ranges, binocular accommodative rock becomes another step in the treatment sequence. In a patient with a convergence excess profile, plus/plus flipper therapy will help the patient understand the concept of relaxation from a different perspective. In some patients, it also becomes obvious that we should recommend a near point prescription as part of the patient's therapy program. In my experience, a bifocal will be preferred to a single vision lens because of potential blur at distance with the latter lens.