Vision Therapy’s Role in Basic Intermittent Exotropia: A Case Report
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ABSTRACT
Introduction
Vision therapy has been shown to be a successful treatment option for basic intermittent exotropia as long as a complete workup is performed to assess prognosis and appropriate management.

Case Presentation
A 9 year old hispanic male presented to the clinic for a comprehensive exam and was subsequently diagnosed with a basic type intermittent exotropia with a V-pattern deviation.

After thorough evaluation of binocular skills and accommodative function with a binocular vision evaluation, he was referred for a vision therapy program to improve fusional ranges, accommodative function, and symptoms. This program consisted of 20 sessions and significantly improved his binocular skills.

Discussion
Basic intermittent exotropia can be treated in various ways. Vision Therapy is a worthwhile option. Surgical correction and overminus treatment have also been effective treatments. Assessment should include the intermittent exotropia control scale and the convergence insufficiency symptom survey. Vision therapy treatments focus on diplopia awareness, anti-suppression, and fusional vergence ranges.

Conclusion
Though more research is necessary, vision therapy has been proven to be a very effective treatment option in basic intermittent exotropia.

INTRODUCTION
Intermittent exotropia exhibits many different clinical presentations. In order to effectively treat the condition, a full evaluation must be performed to assess the magnitude of the deviation, the pattern of the deviation, the presence of anomalous retinal correspondence, and the control score of the deviation. These factors all contribute to decisions on proper treatment and management. While high magnitude intermittent exotropia may tend to require surgical correction, there are many patients who might be able to forgo this option and solely rely on vision therapy to improve symptoms and control of their deviation. Orthoptics or vision therapy has been shown to be an effective treatment in 88.3% of basic intermittent exotropia cases in a study performed in 2009. This case specifically details the orthoptic treatment of basic intermittent exotropia with a V-pattern deviation.
A 9-year-old Hispanic male presented to the clinic on 04/13/2018 for a routine eye examination. This visit was managed by another provider. Due to the nature of our clinic, patients are frequently comanaged in our binocular vision service. He was recently treated for a mild corneal abrasion with artificial tears. He reported no complaints except occasional itching, yet his mother reported having had noticed his eye “wander” at the age of 6. His medical and family histories were unremarkable. He had no known allergies and was not currently taking medications. He previously had occupational therapy for poor handwriting skills. The patient was oriented to time, person, and place. His uncorrected visual acuities were 20/20 in both the right and left eye and .4/.3M- at near in the right and left eyes. Best corrected acuities were 20/20 OD and OS with +0.25sph OD and +0.50sph OS. Pupils were equal round and reactive to light with no afferent pupillary defect. Confrontation fields were full to finger counting in each eye and extraocular muscles had full range of motion. Intraocular pressures were measured with a non-contact tonometer as 14mmHg OD and 12mmHg OS. Color vision was normal with the Ishihara color vision test OD and OS and he had 25 seconds of local stereopsis with randot stereopsis testing. Cover test revealed a 25 pd basic intermittent exotropia as the magnitude was the same at both distance and near with equal fixation preference. In up gaze, the magnitude of the exotropia increased to 35 prism diopters and in downgaze reduced to 22 prism diopters consistent with v-pattern exotropia. His near point of convergence (npc) with an accommodative target was fairly normal with a break at 2.5cm and recovery at 5cm, however, with a penlight his npc receded to a 12.5cm break with no recovery. He displayed good positive voluntary convergence and his step vergences at near were BI, no blur, break at 12pd, recovery at 10pd and BO, no blur, break at 12pd, recovery at 10pd. He had reduced accommodative amplitudes of 8.5D in the right and left eyes. Anterior segment examination showed Van Herrick angles of 4 OD and OS, normal adnexa OU, normal lids and lashes OU, a clear cornea with negative NaFl staining, papillae on the inferior palpebral conjunctiva OU, white and quiet bulbar conjunctiva OU, normal iris OU, deep and quiet anterior chambers OU, and clear lenses OU. He was then dilated with 1 drop of tropicamide 1% and 1 drop of phenylephrine 2.5%, OD and OS. Fundus evaluation was unremarkable with clear vitreous OU, flat, sharp and good color optic nerves with cup to disc ratio in the OD of .55/.55 and .5/.5 in the OS. His maculas were flat with no hemorrhages, exudates, pigmented changes, or macular edema OD and OS, normal vasculature OU, and a flat and intact periphery OU.

The differential diagnoses of this case include:

- Basic Intermittent Exotropia
- Divergence Excess Intermittent Exotropia
- Convergence Insufficiency Intermittent Exotropia
- A Pattern Exotropia
- V Pattern Exotropia
- Decompensated Exotropia

- Basic intermittent exotropia classically presents with a deviation of equal exo deviation at distance and near and also presents with a normal AC/A ratio.
- Divergence excess intermittent exotropia presents as a higher magnitude exo deviation at distance and lower magnitude at near. The AC/A ratio would be higher than normal.
- Convergence insufficiency intermittent exotropia demonstrates a higher magnitude exo deviation at near than distance. The AC/A would be lower than normal.
• A pattern exotropia presents with an exo deviation of greater magnitude in downgaze.
• V-pattern exotropia has an exo deviation of greater magnitude in up-gaze.
• Decompensated exotropia occurs in the adult years while in childhood it manifests as a heterophoria. As this child is 9 years old, this is an unlikely diagnosis.

The patient presented with an alternating fixation deviation of equal magnitude at distance and near at intermittent intervals as well as a deviation which was of higher magnitude in up-gaze and lower magnitude in downgaze. Therefore, this patient was diagnosed with a V-pattern basic intermittent alternating exotropia. He also was diagnosed with a secondary accommodative insufficiency based on his mildly reduced accommodative amplitudes. His mother was educated on the findings and a complete binocular vision workup was recommended and a referral for vision therapy given. Due to the mild hyperopia noted OU and the potential for plus lenses to increase the magnitude of the exo deviation, no spectacle correction was given at this time.

Though this was the initial visit, it would have been helpful to also have information regarding his AC/A by assessing cover test with a +1.00sph lens OU as well as his potential for random dot global stereopsis.

**Binocular Vision Evaluation Follow Up 1**

The patient presented two months later for his binocular vision evaluation. This visit was performed by another provider in the clinic as well. At this visit, the patient notes that he does experience diplopia at distance and near, but he is able to blink and it “goes away”. He occasionally has headaches which are managed with over the counter medications. All medical and ocular history, entrance testing, anterior segment evaluation, and undilated examinations revealed stable findings.

Binocular vision testing was performed as well as a Convergence Insufficiency Symptom Survey, on which he scored 20. Cover test with correction was measured as 20PD IAXT at distance and near. Comitancy testing was performed without correction at this visit and showed 30PD exo in primary gaze, 25PD exo in right gaze, 25PD exo in left gaze, 35PD exo in up gaze and 16PD exo in down gaze with a control score in primary gaze of 1-2 based upon the intermittent exotropia control scale. Worth 4 Dot testing showed fusion at distance and near in bright and dim lighting; at intermediate the patient reported intermittent suppression and fusion. Step vergences at near were BO break at 10PD, recovery at 6PD and BI Break at 10PD, recovery at 6PD. Accommodative amplitudes were 7.14D OD and OS. Extraocular muscle testing revealed a mild overaction of the inferior oblique. Stereopsis testing showed 250 seconds of random dot stereopsis. Near point of convergence with accommodative target was break at 21cm with recovery of 25cm. Repeated with a +1.00sph lens was a break at 20cm and recovery at 28cm. This was performed with a penlight and the break was 31cm and recovery and 33cm and with a red lens it was break at 24cm and recovery at 28cm. This information is significant as near point of convergence testing was dramatically different between previous examination and this visit. However, this is due to fatigue as NPC was performed near the end of testing and repeated by the attending optometrist. Also, retesting the NPC with a +1.00sph lens without significant improvement shows that this patient did not present with a pseudo-CI or accommodative insufficiency driven convergence insufficiency. Patient reported crossed diplopia using the red lens and penlight. Binocular accommodative facility was 9 cycles per minute. Monocular accommodative facility was OD 11 cycles per minute and OS 10 cycles per minute. Vergence Facility at near with 12BO and 3 BI was 14 cycles per minute. MEM with a grade level 2
text was OD and OS +0.25 sph. Bagolini testing was performed. The patient reported an X when aligned and diplopia when dissociated signifying normal correspondence. With the Hering Bielschowsky After Image test with the vertical flash over OD, the patient reported normal correspondence. The mother and patient were educated on vision therapy as the treatment plan and a re-evaluation approximately every 12 weeks to determine if more vision therapy would be necessary.

**Treatment and Management Vision Therapy**

Vision Therapy consisted of 20 sessions of in-office vision therapy for which I was the direct provider. These sessions occurred once per week for 45 minutes with supplemental home therapy activities to last anywhere from 15-20 minutes per day. The goals of therapy were to show improvement in function and fusional ranges, accommodative function, and reduction of the patient’s complaints of headaches, and diplopia. The first 3 sessions of therapy focused on positive fusional vergence training, diplopia awareness, accommodative facility and amplitude. Therapy techniques utilized in this training were Brock string, Multiple Choice Vergence RDS on the Computer Vergence programs, Red Green Ratchet, BO Vectograms, and Monocular Near Far Hart Chart.

After these sessions and once his convergence skills were improved, negative fusional vergence skills and saccadic skills were introduced into the treatment protocol. The activities used were Vectograms, Tranaglyphs, Aperture Rule, Computer Vergence Activities, Monocular Loose Lens Rock, Hart Chart Saccades, and SVI saccades.

Significant improvement was noted by the seventh session therefore, barrel card, lifesaver cards, and eccentric circles were added to the program. As fusional vergence skills improved, the computer program activities shifted from RDS targets to flat fusion targets, jump vectograms and distance projected vectograms were also utilized.

After 14 sessions a re-evaluation was performed, and results are shown below. However, due to poor performance on saccadic activities, 6 more sessions were performed focusing on saccadic function. The remainder of these sessions were focused on saccadic dysfunction while still using a few vergence and accommodative activities. The saccadic activities used were Hart chart saccades both regular and split Hart chart, VIPS character searching, Ann Arbor Tracking™ SVI saccades and rotator, tachistoscope, visual tracings, and track and read. At the completion of the last therapy session, the Developmental Eye Movement Test™ was performed which showed normalized saccadic function. The parent and patient were educated on continuing home therapy activities for maintenance and to schedule a binocular vision follow up appointment in 6 months.
DISCUSSION

Basic exotropia by definition is an exo deviation of equal (within 5 p.d.) magnitude at distance and near. “There is no agreement as to the underlying physiology of divergent strabismus, nor is there definite agreement as to treatment.” 6 Some believe that it occurs “as a result of … obstacles to development or maintenance of binocular vision and/or due to defective action of the medial rectus muscles.” 7 Duane was of the opinion that “exodeviations are caused by an innervational imbalance that upsets the reciprocal relation-
incorporate the opinions of both Duane and Bielschowsky. New research into the structure of extraocular muscles by Bruenech details the implication of a “congenital scarcity” of MIFs, multiply innervated fibers, “which constitute 18-23% of all fibers” within extraocular muscles as contributory to the etiology of oculomotor anomalies. This could bring in new information into the pathophysiology of extraocular muscles and their influence in strabismic deviations. Intermittent exotropia deviations are “controlled by fusional mechanisms and [often are] most noticeable when children are tired, sick, inattentive or after long time near reading task” as this is when breakdown of fusional control mechanisms is most likely to occur. These deviations may occur from a variety of factors including changes to extraocular muscle anatomy, loss of fusional control, or convergence insufficiency. Intermittent exotropia comprises between 50-90% of all exotropias. The overall prevalence is about 1% in the general population. This patient also presented with a V-pattern type deviation which is present in about 30% of all strabismus patients.

Treatment modalities have varied depending on the magnitude of the deviation. Many recommend surgical intervention, but “for exotropia of 25pd or less, orthoptics is the treatment of choice.” This number is particularly important for this patient as the deviation was less than 25pd at distance and near. Surgical intervention would require significant post-operative care and is not always predictable. In fact, surgical treatment of exotropia alone has a 42% success rate. Long term follow up in IXT patients with surgical intervention (approximately 6.1 years) was studied by Hardesty and was reported to be 32%. Another study at the Jules Stein Eye Institute and Department of Ophthalmology, David Geffen School of Medicine at UCLA reported that after 10 years, the surgical success for intermittent exotropia using both motor and sensory criteria was 38% while using motor criteria alone was 64%. The success of orthoptics alone in basic exotropia has been reported as high as 88.3%. Long term success of treatment modalities for intermittent exotropia still require much research however, William Ludlam and Burton Kleinman from the Optometric Center of New York assessed the long range results of 81 strabismus patients who were dismissed from therapy as cured in 1960. The patients were brought back 3-7 years after completion of therapy. Success of orthoptics in all forms of strabismus for cosmetics was 96%. Refractive success was 92% and Flom’s functional cure success was 89%. While this study does not specifically detail long term success of intermittent exotropia, it does show maintenance of success after completion of orthoptic therapy for strabismus. A literature review performed by Zeigler, Huff, and Rouse discussed that for studies using Flom’s functional cure or an equivalent, intermittent exotropia had a 62% cure rate.

Overminus treatment in intermittent exotropia is another option. Often this is performed in children younger than 7 years of age. This treatment protocol is still being studied for effectiveness of long-term control after discontinuing overminus prescription. The Pediatric Eye Disease Investigator group performed a pilot study on children age 3-6 years old with Intermittent Exotropia and overminus therapy of -2.50D. This showed improvement in control of the distance deviation after 8 weeks. However, this was not considered for this case due to the patient’s complaint of near point symptoms, his mild secondary accommodative insufficiency, the age of the patient and the potential for side effects similar to the symptoms that this patient was already experiencing. There is little research into the long-term effectiveness of overminus lenses for intermittent exotropia however, this was addressed by the Pediatric Eye Disease Investigator Group who recommended more
research in a longer randomized treatment trial and research to determine lasting effects of control of IXT after discontinuing treatment.\textsuperscript{15}

In assessing the potential of success with implementing therapy, evaluation incorporating the Intermittent Exotropia Control Scale\textsuperscript{16} is warranted. This patient had fairly good control of his intermittent exodeviation and did not display exotropia until dissociated. As he was scored as a 1-2 initially, demonstrating he recovered from 1-5 seconds or >5 seconds, this showed a good prognosis, as the goal of therapy is to improve control to a scale of 1.

In intermittent exotropia, vision therapy should include not only vergence therapy but also anti-suppression and diplopia awareness techniques progressing in difficulty to flat fusion activities. This aids in continued maintenance and control of the exo deviation after completion of vision therapy.\textsuperscript{17} This treatment protocol was followed for this patient and contributed to the success of his management. The therapy approach to treating exotropia begins with motor processing and extends to sensory processing.\textsuperscript{18} As noted in the Clinical Management of Strabismus, the goals of exotropia treatment include the following:\textsuperscript{22}

- Take advantage of voluntary convergence
- Stimulate strong accommodative convergence response
- Teach eye movement awareness
- Stabilize voluntary vergence convergence control
- Establish sensory fusion at the ortho position
- Teach diplopia awareness whenever dissociated
- Teach fast voluntary convergence recovery of IXT
- Teach accommodative accuracy
- Teach fusional convergence accuracy
- Stabilize efficient binocular vision in open visual space

These goals are all achieved by fusional vergence activities, accommodative activities, transition from random dot stereopsis fusion targets to flat fusion targets and creating diplopia awareness for good control of the intermittent exodeviation. This patient completed a therapy program aimed at targeting these specific goals and with good therapy compliance and home therapy maintenance, the patient was able to show good control and fusional vergence ability to compensate for his exodeviation. This patient did not specifically note significant differences in symptoms in alternate positions of age. Therefore, another specific goal for this case was initially working in downgaze, where his exotropia manifested as a smaller deviation and working toward techniques in primary gaze and up gaze. This is consistent with the recommendation that “binocular therapy should be extended from primary gaze into as much of the affected gaze(s) as possible.”\textsuperscript{19} Regarding work on eye movement awareness, it is important to ensure appropriate saccadic therapy treatments are initiated for improvement in fixational accuracy and oculomotor coordination. While the results have yet to be published, Medipol University is in the process of conducting a study on the effect of Oculo-Motor exercises in Intermittent Exotropia.\textsuperscript{20} Clinically, effective oculomotor control allows for better biofeedback mechanisms during vision therapy. Hart Chart saccades as well as other saccadic training tools were utilized in this manner. After week three of vision therapy, these skills were introduced, and the patient was educated on proper utilization of the hart chart for maximum training potential. As a thorough assessment had not yet been performed, a DEM was included during the re-evaluation and subsequently based on performance, increased saccadic training was implemented during the sessions.

New technology has continued to augment the treatment that clinicians and therapists
have been able to provide for intermittent exotropia. The department of Ophthalmology at the Guangdong Eye Institute in Guangzhou, China recently published a study on dichoptic virtual reality training for intermittent exotropia. Their virtual reality technology “used visual perception and neural plasticity training to remove the obstacle in the visual processing channel and repair the defect of visual function by nonsurgical therapy.”21 Their results showed success and improvement in visual sensory perception, stereopsis, and eye position in all 25 intermittent exotropia patients after 6 months of training.21 While this treatment was not available for this patient, this data allows for possible implementation of virtual reality into intermittent exotropia therapy protocols. This study is the first of its kind, researching virtual reality training for intermittent exotropia, and it shows good promise for the future of vision therapy and research with virtual reality implementation in intermittent exotropia.

Symptom improvement is a significant measure of success along with the patient’s alignment and binocular findings. The convergence insufficiency symptom survey was used in this case. While the symptom score did improve, understanding that the responses children give can be unreliable at times is essential in determining true improvement in symptoms. A symptom score of greater than or equal to 16 is clinically significant in diagnosing convergence insufficiency.22 Though our patient did not have a CI type intermittent exotropia, he displayed some of the clinical measurements correlating with convergence insufficiency including low positive fusional vergence and a reduced near point of convergence. A recent study in 2015 concluded that the convergence insufficiency symptom survey scores “significantly overestimated near visual symptoms in children with normal binocular vision compared with symptoms caused by preferred near activities that require similar amplitudes of accommodation and convergence.”23 While this served as a decent measure of symptom improvement, this specific endpoint number should be referred to only as a decrease in symptoms not a clinically relevant measurement as a consequence of the child’s age. This patient also displayed reduced accommodative amplitudes at initial visit. While they improved from 7.14 Diopters to 10D (still reduced from the minimum of 12.75 D for a 9 year old), this was attributed to this particular patient’s reservation and quiet nature. Throughout therapy, he consistently hesitated to ensure he was correct in his answers. His performance on all other accommodative testing was normal and he was no longer symptomatic at the end of the course of vision therapy.

CONCLUSION
This case demonstrates that basic type intermittent exotropia has the potential for significant improvement with vision therapy treatment alone. It is important when evaluating these patients to provide continuity of care with the provider as well. This was a significant limitation in this case as the vision therapy provider and initial evaluations were performed by different optometrists. When evaluating these patients, testing for alignment, magnitude of deviation, control, accommodative function, anomalous retinal correspondence, and symptoms are significant in assessing prognosis and in monitoring progress. While there are many different avenues for treatment, the age of the patient, the prognosis, and assessing the motivation of the patient should play a key role in the decision for vision therapy.

If vision therapy is advised, an appropriate management plan should be devised including; diplopia awareness, anti-suppression, fusional vergence techniques, accommodative techniques, saccadic activities and eventually flat fusion to aid in maintained control of exodeviation in free space. Appropriate re-evaluations should be performed and
consistent monitoring of progress throughout therapy sessions is required in order to increase demand and performance. Another limitation of this case is that the parent and patient did not understand that improvement in symptoms and cosmetic alignment alone were not the only measurable factors for completion of therapy. This is often a significant reason why patients might choose to discontinue therapy. However, should this occur, the patient may experience regression of symptoms and control of ocular deviation. It is difficult to quantify a “full course” of vision therapy as the exact number of sessions needed for each patient can vary due to unique presentation of binocular vision deficits. However, for this case, if the parents and patient were interested in continuing with vision therapy, each activity would have been continued until all goals and endpoints of the program activities were achieved. As the patient noted significant improvement, he was graduated from the program, given activities for home therapy and was scheduled to return for a maintenance evaluation in 6 months.

Vision therapy is a significant and sufficient treatment option for those patients who would benefit from its training. Though more research needs to be completed on intermittent exotropia, the current treatment modalities have shown great success either with vision therapy alone or in conjunction with other peer reviewed or conventional treatment options.

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