A Tale of Intermittent Exotropia and Amblyopia – Does Vision Therapy Help?

Jameel Rizwana Hussaindeen and T.S. Surendran

Among the types of exotropia in childhood, intermittent exotropia (IXT) has been reported to be the most common type. In a population-based cohort,\(^1\) the prevalence of exotropia has been reported to be 1%, with convergence insufficiency and intermittent exotropia being the commonest of the subtypes. A recent large population-based cohort\(^2\) of 5831 preschool children reports a prevalence of 3.2% of intermittent exotropia, with the basic and divergence excess being the most common of the subtypes. In a long-term follow-up\(^3\) of 184 paediatric patients over 9 years, 3.6% of children resolved; and over a 20-year period, 52.8% of the subjects had an increase in the angle of deviation by more than 10 prism diopters.

In the management of IXT, surgery plays an important role in subjects who tend to increase in their angle of deviation and have associated visual and quality of life issues. The role of conservative management options like vision therapy still remains equivocal and no substantial evidence is available for the same.

This case report emphasizes the role of vision therapy in the management of intermittent exotropia. Ms. H.V. a 6-year-old female with a diagnosis of intermittent exotropia and amblyopia was successfully managed with vision therapy. The child improved in aspects of both visual acuity and visual efficiency.

HISTORY

H.V., a 6-year-old female was brought by her mother with complaints of intermittent outward deviation since 2 years of age with increased frequency and difficulty in viewing far objects since the past 2–3 months. There were no other specific complaints. The child had been advised to use eye glasses by the local optometrist and was also advised to undergo ocular surgery for strabismus by the local ophthalmologist. Birth history was insignificant except that the mother had tuberculosis during the fourth month of pregnancy and was on treatment for the same. The child’s developmental milestones were normal and academic performance was good. There was a family history of exotropia in the maternal aunt. The child had not started to use any eyeglass prescription. The diagnostic data are provided in Table 1.

PROGNOSIS AND GOALS

This patient has amblyopia secondary to anisometropia and an added component of intermittent exotropia. Treatment of amblyopia and divergence excess were sequenced with amblyopia therapy first. While in some cases refractive error correction alone is considered to treat amblyopia, at times additional treatment is required. Glasses were prescribed based on the subjective acceptance after the cycloplegic refraction and a follow-up visit was scheduled for 1 month. The visual acuity in the left eye improved to 20/50 and the right eye visual acuity remained the same. The parent felt that the deviation was reduced with glasses. Since the visual acuity did not improve to 20/20 with refractive adaptation alone, part time patching of OD for 4 h/day with near visual activities was advised.

Based on the study regarding effectiveness of refractive correction alone by the PEDIG investigators,\(^4\) it has been reported that 75% of their sample improved by two lines with only refractive correction over a 25-week follow-up. Our subject had amblyogenic risk factor of both strabismus and anisometropia and hence, patching was initiated after 4 weeks of refractive adaptation. The child returned for a follow-up examination 2 months later and visual acuity improved to 20/25 in the right eye and 20/30 in the left eye. The refractive error remained stable when assessed at this point of time. A trial of vision therapy was decided to be administered in discussion with the ophthalmologist considering the age and the control of deviation. The parent was explained the need for surgical management in the absence of improvement in sensory and motor fusion with vision therapy. The general recommended therapy sessions are between 24 and 36 visits as recommended by Scheiman and Wick (2008).\(^5\) Vision therapy was initiated after the second follow-up. Binocular vision assessment was done at the beginning of vision therapy and the relevant details are as listed below (Table 2).

The primary goal in the presence of normal retinal correspondence in Divergence excess is to eliminate suppression, train diplopia awareness, and to sequence fusional training, beginning from third-grade stereopsis to first-grade simultaneous macular perception. Based on this approach, the four general goals for vision therapy were to

1. Eliminate suppression, developing the awareness of physiological diplopia and development of third degree fusion
2. Incorporate techniques to train vergence amplitudes and second degree fusion skills

### Table 1: Diagnostic Data

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Acuity (OD)</td>
<td>20/40</td>
</tr>
<tr>
<td>Visual Acuity (OS)</td>
<td>20/50</td>
</tr>
<tr>
<td>Refractive Error (OD)</td>
<td>-3.00, -1.50</td>
</tr>
<tr>
<td>Refractive Error (OS)</td>
<td>-1.50, +0.50</td>
</tr>
</tbody>
</table>

### Table 2: Goals for Vision Therapy

<table>
<thead>
<tr>
<th>Goal</th>
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<tbody>
<tr>
<td>1. Eliminate suppression, developing the awareness of physiological diplopia and development of third degree fusion</td>
</tr>
<tr>
<td>2. Incorporate techniques to train vergence amplitudes and second degree fusion skills</td>
</tr>
</tbody>
</table>
3. Develop first degree fusion skills and the dynamics of vergence

4. Train eye-hand coordination skills, accommodation and oculomotor skills (incorporated during every phase of the vision therapy) along with the other training.

The sequential phases of therapy used for these patients include

1. Refractive adaptation for distance
2. Anti-suppression training for amblyopia combined with Monocular accommodation, fixation and ocular motility training
3. Gross vergence and training to appreciate physiological diplopia
4. Smooth and Jump vergence training
5. Binocular accommodation training
6. Integration of procedures

The details of vision therapy provided in phase 1 are given below.

Phase 1 (20 sittings over a month period)

- Anti-suppression training with red-green bar reader
- Cheiroscopic tracings
- Pen light and red filter along with prism dissociation
- Computer Orthoptics (Anti-suppression and vergence)
- Brock string
- Accommodative rock therapy (Monocular and binocular)

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**Table 1: Visual efficiency testing at baseline**

<table>
<thead>
<tr>
<th>Diagnostic data</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncorrected visual acuity (with Snellen chart)</td>
<td>OD: 20/40, Near: 6/6 at reading range 20–45 cm</td>
</tr>
<tr>
<td></td>
<td>OS: 20/200, N6/6 at reading range 20–30 cm</td>
</tr>
<tr>
<td>Dry refraction</td>
<td>OD: −0.50 DS</td>
</tr>
<tr>
<td></td>
<td>OS: −3.50 DS/− 3.50 DC X180</td>
</tr>
<tr>
<td>Cycloptic refraction</td>
<td>OD: −0.50 DS/− 1.00 DC X180</td>
</tr>
<tr>
<td></td>
<td>OS: −3.00 DS/− 3.00 DC X180</td>
</tr>
<tr>
<td>Subjective acceptance</td>
<td>OD: −0.50 DS/− 1.00 DC X180 (20/30)</td>
</tr>
<tr>
<td></td>
<td>OS: −3.00 DS/− 3.00 DC X180 (20/60)</td>
</tr>
<tr>
<td></td>
<td>Binocular visual acuity −20/30</td>
</tr>
<tr>
<td>MEM retinoscopy</td>
<td>OD: +0.50 DS OS: +0.75 DS</td>
</tr>
<tr>
<td>Ocular motility (ductions and versions)</td>
<td>Full and free (OU)</td>
</tr>
<tr>
<td>Stereopsis</td>
<td>Unable to appreciate using random dot stereopsis</td>
</tr>
<tr>
<td></td>
<td>400 arc seconds (Wirt circles in Randot stereopsis)</td>
</tr>
<tr>
<td>Worth four dot test</td>
<td>Fusion for near, and left suppression for distance (33 cm and 6 m) (in both dark and ambient lit room)</td>
</tr>
<tr>
<td>Cover test</td>
<td>Intermittent exotropia – left exotropia (IXT) for distance and near</td>
</tr>
<tr>
<td></td>
<td>Breaks spontaneously for distance; poor control for distance.</td>
</tr>
<tr>
<td></td>
<td>New Castle Score: 4/9 (Home control + Clinic control)</td>
</tr>
<tr>
<td>Alternate Prism Cover Test (APCT)</td>
<td>40 Δbase in for distance</td>
</tr>
<tr>
<td></td>
<td>25 Δbase in for near</td>
</tr>
<tr>
<td>APCT with cycloplegic prescription in trial frame</td>
<td>30 Δbase in for distance</td>
</tr>
<tr>
<td></td>
<td>15 Δbase in for near</td>
</tr>
<tr>
<td>Fixation (with accommodative target)</td>
<td>Central, Steady and maintained for distance and near (OD)</td>
</tr>
<tr>
<td></td>
<td>Central, steady and unmaintained for distance (OS); maintained for near</td>
</tr>
<tr>
<td>Anterior segment and posterior segment examination</td>
<td>Within normal limits based on Slitlamp Bio-microscopy and Indirect Ophthalmoscopy</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Anisometropic amblyopia (OS)</td>
</tr>
<tr>
<td></td>
<td>Intermittent left exotropia</td>
</tr>
<tr>
<td></td>
<td>True divergence excess</td>
</tr>
<tr>
<td></td>
<td>Astigmatism (OU)</td>
</tr>
<tr>
<td></td>
<td>Myopia (OU)</td>
</tr>
</tbody>
</table>
Home reinforcement opaque Life Saver cards, Eccentric Circles and Brock string

Follow-up:

Visual acuity - 20/25 in OD and OS

After the first phase, review of findings suggested improvement in visual acuity, improvement in fusion and binocularity, no change in stereopsis and improvement in near positive fusional vergence. While the binocular visual acuity was assessed, the child exhibited a small face turn towards the left and also occasional blur for distance especially while performing distance fusional vergence activities. Though the deviation was comitant, the face turn could not be explained. An over refraction did not reveal a change of refraction and dynamic retinoscopy revealed normal accommodative response. Ocular motility was full and cover test was repeated with a -1.00 DS above the patient’s glasses. The distance angles reduced by 8 prism dipters in primary gaze and for near the child had an insignificant small exophoria. With adaptation for about 30 min, the face turn almost disappeared. Binocular visual acuity also improved to 20/15 with the over minus lenses. The near visual acuity, amplitude of accommodation and the working distance ranges were normal. The calculated accommodative convergence/accommodation (AC/A) ratio is high in divergence excess due to the

<table>
<thead>
<tr>
<th>Review after 2 months</th>
<th>Visual acuity (with glasses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD: 20/25, Near: 6/6 @20–45 cm</td>
<td></td>
</tr>
<tr>
<td>OS: 20/30, Near: 6/6 @20–30 cm</td>
<td></td>
</tr>
</tbody>
</table>

Binocular vision assessment

Worth four dot test: fusion for near and alternate suppression for distance

MEM retinoscopy: OD and OS: +0.50 DS

Near point of convergence (NPC):

With red filter and penlight: 25/30 cm (break/recovery)

With accommodative target:

Subjective & Objective: 15/20 cm (break/recovery)

Amplitude of accommodation (AA) (push-up method):

- OD: 17 D OS: 17 D OU: 18 D
- NRA: +2.00 DS PRA: -2.00 DS
- APCT (with glasses): 30 ΔBI for distance and 15 Δ BI for near
- Gradient AC/A ratio: 7/1
- Calculated AC/A ratio: 10.4/1 (IPD: 55 mm)
- Binocular accommodative facility testing (+2.00/-2.00 DS accommodative flippers with N8 Word rock card): 7 cpm (difficulty with plus lenses)
- Vergence Facility Testing (12 BO/3 BI vergence flip prisms) at 40 cm: 6 cpm (Difficulty with BO prisms)
- Fusional vergence range (using RDS targets at 40 cm)
- PFV: 12Δ / 4 Δ(Break/ Recovery)
- NFV: 20Δ / 14Δ (Break/ Recovery)
- Saccades and Pursuits: Within Normal Limits
- Step vergence
  - NFV Distance X 10 4
  - Near X 25 20
- PFV Distance 10 12 10
- Near 8 10 4

Diagnosis

- Divergence excess
- Reduced PFV amplitudes
- Receded NPC
- Reduced vergence facility

Table 2. Visual efficiency assessment before vision therapy
difference in exodeviation between distance and near, but the response AC/A ratio is typically found to be normal. In IXT, when patients tend to use their excessive convergence accommodation in an attempt to converge that results in distance blur. In such cases, high convergence accommodation/convergence (CA/C) ratio is considered to be an indicator to prescribe minus lenses for distance. Though we do not routinely measure this in the clinical set-up, complaints of distance blur while trying to fuse is an indication of inability to inhibit accommodation due to high CA/C ratio. Based on these factors, an over minus prescription of OD: \(-1.50 \text{ DS} / -1.00 \text{ DC X} 180\) OS: \(-4.00 \text{ DS} / -3.00 \text{ DC X} 180\) was given. The second phase of vision therapy was initiated with the new refractive correction.

**The goals of second phase included**

- Train second and third grade fusion at intermediate and far distance
- Train binocular accommodative and vergence facility
- Train eye movements of saccades and pursuits

The details of vision therapy provided in phase 2 is given below.

**Phase 2 (15 sittings over a month period)**

- Vergence therapy with major amblyoscope, Bernell O’Scope and Aperture rule
- Distance vergence training with computerized vision therapy system (VTS4)
- Oculomotor skills (VTS4 and Pegboard)
- Brock string
- Accommodative rock therapy (Monocular and binocular) using VTS 4

At the end of second phase of vision therapy, the angle of deviation for distance was well controlled (NCS – Control score 2/9) and reduced to 20ΔBI (with the \(-1.00 \text{ DS over-minus prescription}\)). The patient achieved desirable levels of improvement using the Aperture Rule, Bernell O’Scope, Variable Tranaglyphs (could work with more central targets) and the VTS 4 system using second-degree fusion targets. Vergence facility still remained poor and hence the next phase focused on phasic training and vergence facility. Home reinforcement was prescribed at this stage and a follow-up after 6 months was advised. During follow-up, the vergence parameters and the angle of deviation remained stable and the third phase of vision therapy was initiated.

**GOALS FOR THIRD PHASE OF VISION THERAPY**

Move from tonic to phasic training in vergence to emphasize vergence facility at all distance of training.

**Phase 3 (10 sittings over a 2 weeks period)**

- Jump vergence training (variable/ non-variable Tranaglyphs/ Vectograms)
- Jump vergence training with VTS4, vergence flippers and prism trainers
- Home reinforcement using computerized vision therapy software, Distance large eccentric circles

Follow-up (key parameters):

- Vergence Facility Testing: 10 cpm
- Step Vergence:

<table>
<thead>
<tr>
<th></th>
<th>Blur</th>
<th>Break</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFV DISTANCE</td>
<td>X</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>NEAR</td>
<td>X</td>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>PFV DISTANCE</td>
<td>20</td>
<td>25</td>
<td>20</td>
</tr>
</tbody>
</table>

**OUTCOME OF CASE**

The distance angle was well controlled and other parameters were consistent with the re-assessment done following the second phase of vision therapy. The distance NFV was satisfactory, though not perfect. A cycloplegic refraction was done at the end of the final session which revealed OD: \(-1.75 \text{ DS} / -1.00 \text{ DC X} 180\) and OS: \(-4.25 \text{ DS} / -3.00 \text{ DC X} 180\). The child also preferred the new correction and change of glasses were advised.

**FOLLOW-UP CARE**

Home reinforcement was advised using the HTS, and free space fusion techniques (large eccentric circles for distance, Brock string with vergence and accommodative flippers) were prescribed during the third phase. A re-assessment after 1 month showed stable parameters and visual acuity. Need for constant reinforcement and the possibility of a recurrence of the deviation if vision therapy was abruptly stopped, were explained. At 1-year follow-up, the refractive error in the right eye had progressed to OD: \(-2.25 \text{ DS} / -1.00 \text{ DC X} 180\) and left eye remained stable with no progression of myopia. Over a 3-year follow-up, there has been no specific visual symptoms with stable parameters of ocular deviation and vergence.
DISCUSSION

This is an unusual presentation of intermittent XT in which the IXT was also associated with anisometropic amblyopia. The result was resolution of the amblyopia along with a significant improvement in the vergence parameters with good control of angle of deviation.

The uniqueness of this case include the protocol of vision therapy adopted for amblyopia and IXT customized based on the clinical parameters, and the long-term follow-up with successful maintenance of the achieved improvement. This opens up a new option in the conservative management of IXT, when surgery is not indicated or not attempted due to patient/parental factors as in our case. Another uniqueness is the prescription of over-minus lenses to improve the control of IXT for distance, based on the assumption that an elevated CA/C ratio caused distance blur and an associated AHP to clear the image. As clinical measurement of CA/C is complicated by the measurement protocol in itself, there are no guidelines as to how much over-minus should be prescribed, and how long it should be prescribed. It could be argued that the over-minus resulted in the progression of myopia, but there is no scientific basis to this argument. We consider that the progression of myopia was coincident to the case, and not related to the over-minus prescription. Also the refractive error remained stable during the follow-up periods. In the management of IXT, surgical correction has been recommended as a standard approach in patients with deteriorating control and increase in the angle of deviation. In a randomized controlled trial for IXT, that compared patching with observation of children between 3 and 10 years of age, both the approaches have been reported to show comparable outcomes in the deterioration of angle in children with previously untreated IXT. In younger children between 12 and 35 months of age, part time patching did not show any advantage over observation on the control of angle of deviation. The angle of deviation and the control scores remained stable in both the patching and observation group over a 6-month follow-up in a randomized controlled trial comparing part-time patching with observation for children 3 to 10 years of age with intermittent exotropia. Orthoptic intervention through vision therapy has been recommended as one of the conservative management options for IXT by many authors. Some of the compiled findings in a recent review suggests surgical management combined with vision therapy as an appropriate option. All these findings point to the lacunae in the literature for standardized clinical trials proving the efficacy of these treatment options.

Vision therapy in the management of non-strabismic binocular vision anomalies like convergence insufficiency has gained increasing evidence in the past decade. Convergence insufficiency (CI) is a common binocular vision anomaly resulting in symptoms of eyestrain, blurred vision and asthenopic symptoms associated with near task. The convergence insufficiency treatment trial (CITT) showed the efficacy of Office-based vision therapy as against conventional pencil push-up exercises and home-based vision therapy in convergence insufficiency over a 12-week period. Sustained improvements in signs and symptoms were reported in 73% of study subjects. In this study, home-based pencil push-ups was not efficacious in improving the signs and symptoms and was comparable to the placebo treatment. The mechanism of vergence therapy in CI was established in a recent study, where apart from improvements in clinical signs and symptoms, the neural substrates using fMRI revealed an increase in the percent signal change of functional activity in the frontal eye fields, posterior parietal cortex and the cerebellar vermis. These results strengthen the role of vision therapy in the management of binocular vision anomalies, though there is scarce data specifically on vision therapy for IXT.

Through this case report, we emphasize the role of vision therapy as a conservative management in the long-term follow-up of patients with IXT, for whom surgical management is not advocated or postponed.

CONCLUSION

This case report proposes vision therapy as a conservative management option in the management of intermittent exotropia. Vision therapy also plays a significant role in the amelioration of patients’ symptoms and improvement of binocular vision parameters.

REFERENCES


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**Books Published by ESO**

**Practice of Low vision care**

The original version of this book was written by late Dr. E. Vaithilingam, who served as the head of the Elite School of Optometry from February 1991–March 2001. He was an expert in multiple disciplines – Clinical optometry, contact lens and low vision. He was an ardent researcher and pioneer with more than 100 publications to his credit. He was the first person to become a fellow of International Association of Contact lens Educators and a fellow of American Academy of Optometry from India. He was the President of the Indian Optometric Association twice during his lifetime. He initiated the practice of Optometry Day in India to increase awareness about eye care.

The authors of this book are humbled to be given the opportunity to append this book. We sincerely pray that we do justice to his objectives in writing this book. The first edition of this book was in a simple easy-to-understand format, with all the necessary details required to practice Low Vision Care. However, with time, there has been much advancement in the field of Low Vision making it necessary for us to add more information to the book.

This book was written with the primary thought that each patient with Low vision has to be evaluated and managed according to the individual’s task specific visual needs and expectations.

**Dr Santanam’s Text book of Occupational optometry:**

This book is the first of its kind in this subject, derived from years of teaching and research, since the subject’s conception in 1988. As such, this book should provide necessary information for the students in this field, and be immediately applicable given the relevant and concise presentation of materials.

The book is mainly meant as a text book for students undergoing the optometric graduation (4-year course) programme, especially in India. It is also useful for occupational health physician and nurses as well as eye care professionals. Chapters like occupational health, Occupational Hygiene, and occupational diseases are directly relevant to occupational optometry as they provide information of the workplace situation, an integral part to this view branch of optometry. The chapter on accidents, their investigation and implementation of safety (control) measures will be useful. We have also included the classification of accidents/injuries statistics and importantly, impairment assessment as more and more workers are seeking compensation under the law. Additionally, the chapter providing information on the skin has been included for reasons that the skin is the largest organ in the body and the skin of eyelids and surrounding area has commonality with the general skin, example, meibomian glands in the eyelids are the same as the sebaceous glands elsewhere in the skin. The use of cosmetics can cause eyelid irritation and sensitization. The chapter on heat disorder is included due to its intensity and prevalence throughout India, especially in the summer, taking a toll on almost all workers. The remaining chapters cover various topics related to care of the eye, with respect to occupations including sports. The first ever occupational optometry services in India, was started in Sankara Nethralaya (Elite School of Optometry) in the year 2013. The chapter on Visual Task Analysis mainly reflects the work carried out there.

Because it is based on the exposure and experienced heathers received from its alma mater Sankara Nethralaya, the first two books are a rich knowledge base in those specialty areas. The third book is from none other than DR. P. P. Santanam, who coined and introduced the world ‘Occupational Optometry’ to ESO and the country, who guided ESO as its first Principal. Being the brainchild of the ‘pithamaha of Occupational Optometry’, we are sure this will be the Bible for all optometrists in this discipline.