

Evaluation and Management of Refractive Amblyopia with Associated Non Strabismic Binocular Vision Dysfunctions Through Vision Therapy: A Case Report from Nepal

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Abstract

Background: Amblyopia commonly known as “lazy eye” is a unilateral or infrequently bilateral condition in which the best corrected visual acuity is poorer than 6/6 in the absence of any obvious structural anomalies or ocular disease. Anisometric amblyopia is caused by an uncorrected refractive error in which the difference between the corresponding major meridian of two eyes is at least 1D. This refractive difference causes a blurred image in the eye with the greater refractive error disrupting the normal neurophysiological development of the visual pathway and visual cortex. Patients with refractive amblyopia may often have associated non-strabismic binocular vision dysfunctions (NSBVD). In many cases, these associated dysfunctions are undiagnosed and thus left untreated. This case shows the possibility of NSBVD associated with amblyopia and their management through optometric vision therapy.

Case Report: A 21 years old male patient, previously examined by several eye specialists and was diagnosed with amblyopia of the left eye visited our clinic. He was informed that the case was hopeless and was given a spectacle for full time wear. He was previously advised to do patching but the patient did not comply. Before starting vision therapy, a comprehensive binocular vision evaluation was performed to determine the presence of any NSBVD. Reduced near stereopsis, accommodative dysfunction, convergence insufficiency and oculomotor dysfunction were documented. Soft contact lens was prescribed for his amblyopic eye (left) while the other eye did not need any correction. The management plan was combined eight sessions of occlusion and vision therapy per month with soft contact lens on the left eye. After 4 months of optometric vision therapy, the visual acuity of the left eye was improved to 6/6 at 20 feet and N6 at 33cm. A post-vision therapy binocular vision assessment showed marked improvement of visual acuity, stereopsis and successful treatment of accommodative dysfunction, convergence insufficiency and oculomotor dysfunction.

Conclusion: Amblyopia can be associated with non-strabismic binocular vision dysfunctions. A comprehensive binocular vision evaluation is must before initiating amblyopia therapy.

Keywords: Amblyopia; Accommodative Dysfunction; Oculomotor Dysfunction; Convergence Insufficiency; Optometric Vision Therapy

Introduction

Anisometric amblyopia is a well-known clinical entity. Anisometric amblyopia occurs as a result of clinically significant and unequal amounts of uncorrected refractive error. Anisometric amblyopia is caused by an uncorrected refractive error in which the difference between the corresponding major meridian of two eyes is at least 1D [1]. This refractive difference causes a blurred image in the eye with

the greater refractive error disrupting the normal neurophysiological development of the visual pathway and visual cortex [2]. Amblyopia develops due to a unilaterally blurred retinal image [3]. Generally, the greater the anisometropia, the more severe the amblyopia [4-6]. Patients with hyperopic anisometropia with as little as 1 D difference between the eyes may develop amblyopia [7]. Reduced acuity is not the only clinical finding associated with amblyopia; many other conditions may be associated, such as accommodative insufficiency [2,3]. A detailed binocular vision assessment is essential to rule out any binocular vision anomaly. Optometric vision therapy (VT) can be used as a successful treatment modality for refractive amblyopia [8].

Case Report

A 21 years old male patient, previously examined by several eye specialists and was diagnosed with amblyopia of the left eye visited our clinic. He was informed that the case was hopeless and was given a spectacle for full time wear. He was previously advised to do patching but the patient did not comply. There was a normal birth history (full term, caesarean delivery, birth weight- 3.2 kg) and normal developmental milestones. Ocular history was normal.

Upon examination, his distance visual acuity was 6/6 OD and 6/60 OS. Near vision was N5 and N10 @ 33 cm in the OD and OS, respectively, using Snellen near vision acuity chart. Static retinoscopy showed emmetropia OD and moderate hyperopia OS. Cycloplegic refraction was plano OD and +4.00Ds OS. The best corrected visual acuity was 6/12 through the spectacle trial lens OS. Anterior and posterior segment evaluations were unremarkable.

He was diagnosed with anisometropic amblyopia, emmetropia OD, moderate hyperopia OS. He was then referred to the contact lens department and was given a soft contact lens (BC 8.50 mm/power +4.25 DS/diameter 14.5 mm) OS. The best corrected visual acuity was 6/12, N8 @ 33 cm.

At a two-week follow-up visit, the visual acuity remained the same and the fitting was deemed acceptable. After four weeks of adaptation to the new contact lenses, the patient reported for a comprehensive binocular vision assessment and the results obtained from tests namely amplitude of accommodation, near point of convergence, gradient AC/A ratio, monocular accommodative facility and binocular accommodative facility, monocular estimation method retinoscopy and vergence facility were compared with table of established expected values by Scheiman and Wick [9]. The results from tests namely distance and near lateral phoria, negative fusional vergence, positive fusional vergence, negative relative accommodation and positive relative accommodation were compared with expected values from the table of expected values by Optometric Extension Program [10].

The results from Maples Oculomotor Test were compared with minimal acceptable scores for saccades and pursuit by age and sex [11].

Based on the binocular vision assessment, he was diagnosed with:

- Moderate hyperopia OS
- Anisometropic amblyopia OS
- Pseudoconvergence insufficiency
- Exophoria
- Reduced near stereopsis
- Oculomotor dysfunction

Management plan

He was prescribed part-time occlusion [12-16]. OS for two hours daily [16] using an optclude eye patch at home during waking hours while continuing his regular activities like watching television and near activities like reading, writing, drawing, computer use and video gaming [17]. Office-based occlusion and vision therapy eight session per month was initiated.

Vision therapy

Each office therapy session lasted one hour. Visual acuity was measured on every alternate session. Oculomotor therapy (Fixation, saccades, pursuits, eye hand coordination), monocular acuity activities OS and monocular accommodative activities OS, OD were started. Upon completion of the 16th session, his visual acuity improved to 6/9 OS and binocular vergence therapy was initiated. Upon completion of the 26th session, his visual acuity improved to 6/6 OS. The patient underwent a total of 32 therapy sessions over a period of four months.

A comprehensive binocular vision assessment was done at the end of therapy sessions. Table 1 shows the comprehensive binocular vision assessment pre and post vision therapy.

Tests	Pre-Vision Therapy	Post Vision Therapy
Visual acuity(aided)	OD: 6/6, N6 OS: 6/12, N8	OD: 6/6, N6 OS: 6/6. N6
Refractive status	OD: Plano OS: +4.00D	OD: Plano OS: +4.00D
Stereopsis(stereofly)	400 seconds of an arc	40 seconds of an arc
Cover test	Distance: Orthophoria Near: Exophoria	Distance: Orthophoria Near: Exophoria
Prism bar cover test	@20 feet: N/A @40 cm: 11PD exophoria	@20 feet: N/A @40 cm: 4PD exophoria
Extraocular motility test	OU: Full range of motion	OU: Full range of motion
Amplitude of accommodation	OD: 7.14D OS: 6.25D OU: 7.14D	OD: 13.3D OS: 12.5D OU: 14.28D
Negative Relative Accommodation (NRA)	+2.00D	+2.50 D
Positive Relative Accommodation (PRA)	-1.50D	>-3.00D
Monocular accommodative facility (MAF) (±2.00DS)	OD: 8cpm; difficulty clearing minus OS: 6cpm; difficulty clearing minus	OD: 20cpm; equally clears both minus and plus OS:18cpm; equally clears both minus and plus
Binocular accommodative Facility (BAF) (±2.00DS)	4cpm; difficulty clearing minus	14cpm; equally clears both minus and plus
Monocular estimation method (MEM)	+1.25D OU	+075D OU
Near point of convergence (NPC)	15cm	6cm
Negative fusional vergence (NFV)	@20 feet: ×/6/4 @40 cm: ×/16/12	@20 feet: ×/12/6 @40 cm: ×/20/16
Positive fusional vergence (PFV)	@20 feet: ×/10/8 @40 cm: 4/12/4	@20 feet: ×/16/10 @40 cm: 14/20/14
Saccades (NSUCO)	5/3/3/3	5/4/5/5
Pursuit (NSUCO)	5/3/3/4	5/5/4/5

Table 1: Pre and post-vision therapy binocular vision evaluation.

OD: Oculus Dextrus; OS: Oculus Sinister; NSUCO: Northeastern State University College of Optometry.

Appendix A shows the table of excepted for different tests performed and appendix B shows the sequential vision therapy program.

Post-VT, he was advised to reduce the occlusion from two to one hour daily during all visually demanding tasks for the next three months to prevent amblyopia recurrence [18,19]. There is an estimation that 25 - 28% of patients experience some decrease in their visual acuity after treatment [18-23], so a maintenance therapy for vergence (opaque eccentric circle without the help of pointer, pencil push up, twice daily) and accommodation (accommodative rock OD and OS separately, twice daily) was recommended.

After two months follow up visit, the improved visual acuity and other parameters were well-maintained.

Discussion

All therapy goals for the patient were achieved. Thanks to the evidence based research studies in neuroscience, researcher have discovered “neuroplasticity” the ability of the adult brain to rewire itself and form new connection paving the way for amblyopia treatments [24-32]. Optometric vision therapy is rooted in the idea of neuroplasticity. Even if the connection is disrupted in amblyopic patients, the neurons can still be reawaken through training to force it to respond [24-32].

In this case, the patient was 21 years old when we started the therapy. Therefore, 6 years of age (after the sensitive period) is not the upper limit for treating amblyopia [14,24,28-32]. Improvement depends upon the individual’s neuroplasticity [24-32]. Clinical evidence⁸ suggests that residual neuroplasticity remains in the visual system for much longer periods than previously thought [24-32]. Thus amblyopia treatment may be recommended at any age.

Conclusion

Non-strabismic binocular vision dysfunction may be associated with anisometric amblyopia. Acuity should not only be the factor to concentrate when treating amblyopia. Treatment of amblyopia must go beyond visual acuity and include fixation stability, ocular motor control (pursuits and saccades), accommodative skills, contrast sensitivity, stereopsis, visual motor skills and spatial processing (localization). One should do a comprehensive binocular and accommodative assessment before initiating therapy. An excellent outcome can be obtained through a well-designed vision therapy program.

Appendix 1

Case Findings	Expected
Distance lateral phoria	0.50 Exo
Near lateral phoria	6 Exo
Base-out (distance)	Blur/break/recovery:7/19/10
Base-in (distance)	Break/recovery: 9/5
Base-out (near)	Blur/break/recovery: 15/21/15
Base-in (near)	Blur/break/recovery:14/22/18
Negative relative accommodation	+1.75 to + 2.00
Positive relative accommodation	-2.25 to - 2.50

Table A1: Optometric extension program expected.

Test Expected	Finding
Amplitude of accommodation	
Push-up test	18 - 1/3 age
Near point of convergence	
Accommodative target	Break/recovery: 5 cm/7 cm
Gradient AC/A Ratio	4:1
Monocular accommodative facility	
Adults (±2.00 flippers, calling out number or letter on Accommodative Rock Card)	13 - 30 yr old 11.0 cpm
Binocular accommodative facility	
Adults (±2.00 flippers, calling out number or letter on Accommodative Rock Card)	13 - 30 yr old 10.0 cpm
Monocular estimation method retinoscopy	+0.50 D
Vergence facility testing (12 base- out/ 3 base- in)	15.0 cpm

Table A2: Table of expected: Binocular Vision Testing (Scheiman and Wick).

Age	Ability		Accuracy		Head movement		Body movement	
Sex	Male	Female	Male	Female	Male	Female	Male	Female
≥ 14	5	5	4	4	4	4	5	5

Table A3: Maples pursuit test minimal acceptable score by age and sex.

Age	Ability		Accuracy		Head movement		Body movement	
Sex	Male	Female	Male	Female	Male	Female	Male	Female
≥14	5	5	4	3	3	4	5	5

Table A4: Maples saccade test minimal acceptable score by age and sex.

Appendix 2

Sequential vision therapy program

Sessions 1-5

In-office therapy

- Balance board activities
- Walking rail with distance Hart chart (modified)
- Peg board activities
- Pointer in straw
- Swinging Marsden ball
- Monocular loose lens rock with plus and minus with near
- acuity appropriate word rock card

Home therapy

- Patching of non-amblyopic eye 6 hours daily
- Letter tracking in newspaper (Ann Arbor tracking)
- Filling “o” by color in newspaper/magazines
- Accommodative push-up and push-down
- Hart chart accommodative rock
- Video game
- Drawing activities

Sessions 6-10

Office therapy

- Balance board activities
- Walking rail with distance Hart chart (standard)
- Peg board activities
- Pointer in straw

- Hitting Marsden ball by VMC stick
- Marsden ball with minus lens
- Brock string
- Monocular loose lens rock with plus and minus with near acuity appropriate word rock card
- Home therapy
- Patching of non-amblyopic eye 6 hours daily
- Letter tracking in newspaper (Ann Arbor tracking)
- Filling “o” by color in newspaper/magazines
- Accommodative push-up and push-down
- Hart chart accommodative rock
- Video game
- Drawing activities

Sessions 11-15

Office therapy

- Tranaglyphs: convergence only
- Aperture rule: single aperture, convergence only
- Brock string
- Red/green bar reading with red/green goggles
- Vis-à-vis
- Monocular loose lens rock plus and minus in right eye and
- with plus only in left eye
- Peg board with balance board
- Marsden ball with VMC stick

Home therapy

- Occlusion of non-amblyopic eye 3 hours daily
- Opaque eccentric circle with the help of pointer
- Brock string
- Accommodative push up and down in right eye
- Accommodative push down in left eye
- Hart chart accommodative rock

Sessions 16-20

Office therapy

- Tranaglyphs: both convergence and divergence, followed by Vectogram
- Aperture rule: single aperture with plus lens binocularly followed by double aperture
- Brock string with base in and base out prism

- Red/green bar reading with red/green goggles
- Monocular loose lens rock plus and minus in each eye
- Binocular accommodative facility
- Bernell-o-scope
- Peg board with balance board
- Marsden ball with VMC stick

Home therapy

- Occlusion of non-amblyopic eye 2 hours daily
- Opaque eccentric circle without the help of pointer, followed by push up and rotation
- Brock string (bug on string)
- Albee 3 dot convergence card
- Hart chart accommodative rock, each eye
- Hart chart saccade.

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