Article ▸ Relative Amblyopia Secondary to Anisometropia in a Patient with Ipsilateral Optic Nerve Hypoplasia

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ABSTRACT

Background: Optic nerve hypoplasia (ONH) is a developmental disorder in which the optic nerve is small and/or there are fewer than normal nerve fibers present. Visual acuity (VA) loss from ONH ranges from none to severe, depending on the extent of macular nerve fiber loss. It is common for patients with decreased vision from unilateral ONH to develop ipsilateral amblyopia secondary to constant unilateral strabismus or high refractive error. We report a case of unilateral ONH and relative amblyopia associated with anisometropia that is less than the expected amblyogenic amount.

Case Report: A developmentally appropriate 5-year-old Hispanic female, without complaints or previous spectacle wear, presented for a comprehensive eye examination. Best-corrected distance VA through cycloplegic prescription of OD +0.50-1.00x180, OS -2.50-0.50x180 was OD 20/25, OS 20/100 (HOTV with matching). She was orthophoric at distance and near and showed no response to stereopsis testing. Color vision and pupils were normal. Fundus examination revealed ONH OS. Disc-macula to disc diameter ratio was larger OS. Disc area (Heidelberg Retina Tomograph 3) was noticeably smaller OS. VA improved to 20/40 OS after four months of treatment and has remained stable since then. Stereopsis testing after treatment showed a positive response to random dot forms.

Conclusion: Our patient had ONH OS with less than the expected amblyogenic amount of anisometropia. However, VA in the ONH eye improved four logMAR lines with treatment. We conclude that reduced VA from ONH and secondary anisometropia likely led to suppression and relative amblyopia development. We suggest that eye care practitioners attempt patching for selected unilateral ONH patients even if an expected amblyogenic factor is not present. Treatment should be attempted only if the patient's acuity is adequate for patient compliance.

Keywords: amblyopia, anisometropia, occlusion, optic nerve hypoplasia

Background

Optic nerve hypoplasia (ONH) is a developmental disorder in which the optic nerve is smaller than normal and/or has a reduced number of nerve fibers. ONH is the most common congenital optic nerve anomaly.[1] Visual acuity (VA) loss from ONH can range from none to severe, depending on the extent of macular nerve fiber loss. Visual field loss also can range from none to severe and varies according to which nerve fibers are lacking. A recent review of 50 years of epidemiological literature determined that young maternal age and being a first-born child are the most common prenatal factors linked to ONH. This study also revealed that prenatal exposure to drugs is a rare association.[2] It is common for patients with ONH also to develop amblyopia secondary to constant unilateral strabismus or high refractive error in the affected eye.[1] Amblyogenic amounts of anisometropia are usually expected to be >3.00 diopters (D) difference in myopia between eyes, >1.00 D difference in hyperopia, and >1.50 D difference in astigmatism.[3] We report a case of unilateral ONH and relative amblyopia. The vision loss is in addition to that caused by ONH.[4,5] The vision loss in our case is associated with anisometropia that is less than the expected amblyogenic amount in patients who have amblyopia without ONH.

Case Report

A 5-year-old Hispanic female presented for a comprehensive eye examination with no complaints. She had never worn glasses or done any patching. She was born full-term at a normal weight (7 pounds, 12 ounces) and had reached all developmental milestones at the appropriate ages.

Examination findings are listed in Table 1. Monocular distance VA was tested at 10 feet using a computer-based system, the Electronic Visual Acuity (EVA). This method has been commonly used for VA testing of amblyopic patients in our clinic, as well as in amblyopia research studies.[6,7] Single HOTV optotypes with surrounding bars were used according to the Amblyopia Treatment Study VA protocol at each visit. This VA testing method, which controls contour interaction at each level, has been found to be highly reliable and easy to use with children.[8]

Cycloplegia and pupillary dilation were achieved with one drop each of 1% cyclopentolate, 1% tropicamide, and 2.5% phenylephrine, a standard formula at the institution. Cycloplegic retinoscopy found the same sphere powers and only slightly more astigmatic correction in each eye compared to non-cycloplegic refraction, but cycloplegic findings were considered more reliable. We diagnosed our patient with

Table 1: Patient's Pre-Treatment Examination Findings (First Examination)

Unaided VA: Snellen	Distance: OD 20/25, OS 20/300 Near: OD 20/25, OS 20/80
Best-corrected VA: EVA-HOTV with matching	Distance: OD 20/25, OS 20/100
Cycloplegic retinoscopy	OD +0.50 -1.00 x 180 OS -2.50 -0.50 x 180
Cover test (aided)	Ortho, far and near
Stereopsis (Preschool Randot, Stereofly, aided)	Nil
Extraocular muscles	Full range of motion
Color vision (Ishihara)	12/12 plates OD/OS
Pupils	PERRL (-)APD
Anterior segment	Healthy OU
Intraocular pressures (Tonopen, variability 15%)	OD 16 mm Hg, OS 19 mm Hg
Dilated fundus examination	OD: C/D 0.15 OS: hypoplastic nerve, C/D 0.15; healthy macula and peripheral fundus OU
DM:DD ratios	OD 2.44, OS 3.34
Disc area (HRT3)	OD 1.39 mm^2, OS 0.93 mm^2

mixed astigmatism OD and compound myopic astigmatism OS, with 2.75 D anisometropia (spherical equivalent).

The OS disc margins were subtle in appearance due to a partial double ring sign. In our patient, there was a yellowish halo around the disc tissue nasally and temporally, without an inner pigment ring. The location of the optic disc margins was determined using a stereoscopic view. Based on the location of the disc margins, the disc-macula to disc diameter (DM:DD) ratios were calculated for each eye by measuring from photographs the distance between the center of the disc and center of the macula. Horizontal and vertical disc diameters were averaged (Figures 1A and 1B). Heidelberg Retina Tomograph (HRT) was performed. Based on the clinical appearance of the optic disc, smaller disc size by HRT (Figure 2), and a larger DM:DD ratio OS, we diagnosed ONH OS.

Cycloplegic correction was prescribed for full-time wear. After one month of spectacle wear, the VA improved to 20/64. In an attempt to achieve additional VA improvement as quickly as possible, a trial period of opaque direct occlusion (OD) was initiated (two hours/day) using adhesive patches. Specific near eye-hand coordination activities (one-half hour/day) were prescribed for home.[9] Activities included coloring, mazes, computer games, reading, and school homework (all performed monocularly). VA improved to 20/40 OS after three months of patching. Patching continued for approximately four more months without further improvement. The patient's mother chose not to pursue a course of in-office vision therapy. At the patient's next comprehensive eye examination seven months later, best-corrected VA remained 20/40 and stereopsis showed a positive response to random dot forms (500 seconds of arc). Non-cycloplegic subjective refraction had changed by only -0.25 D additional sphere and cylinder power OS. At her most recent visit four years later (age 10 years), subjective refraction and Snellen VA were relatively stable at OD +0.25 sphere (20/20), OS -3.50-0.50x180 (20/40). Table 2 summarizes the VA changes over time.

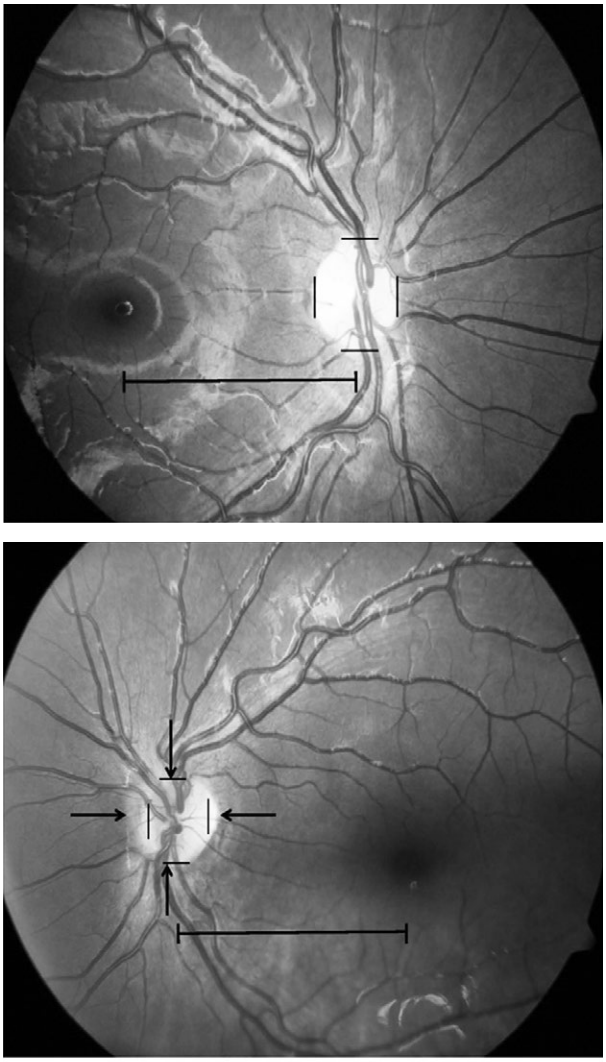

Figure 1A: *Right eye fundus (top) with normal optic nerve.* ***1B:*** *Left eye fundus (bottom) with hypoplastic optic nerve (note subtle double ring sign). Short black lines indicate disc margins, determined by stereoscopic view; arrows indicate outer edge of double ring OS; long black lines indicate disc-macula distance.*

Table 2: VA Changes Over Time (EVA-HOTV)

Date	VA OD	VA OS
01-07-2009 (patient received glasses for full time wear)	20/25	20/100
02-07-2009 (patching started)	20/25	20/64
03-07-2009	20/32	20/50
04-25-2009	20/25	20/40
06-16-2009	20/25	20/40
01-15-2010	20/20	20/40

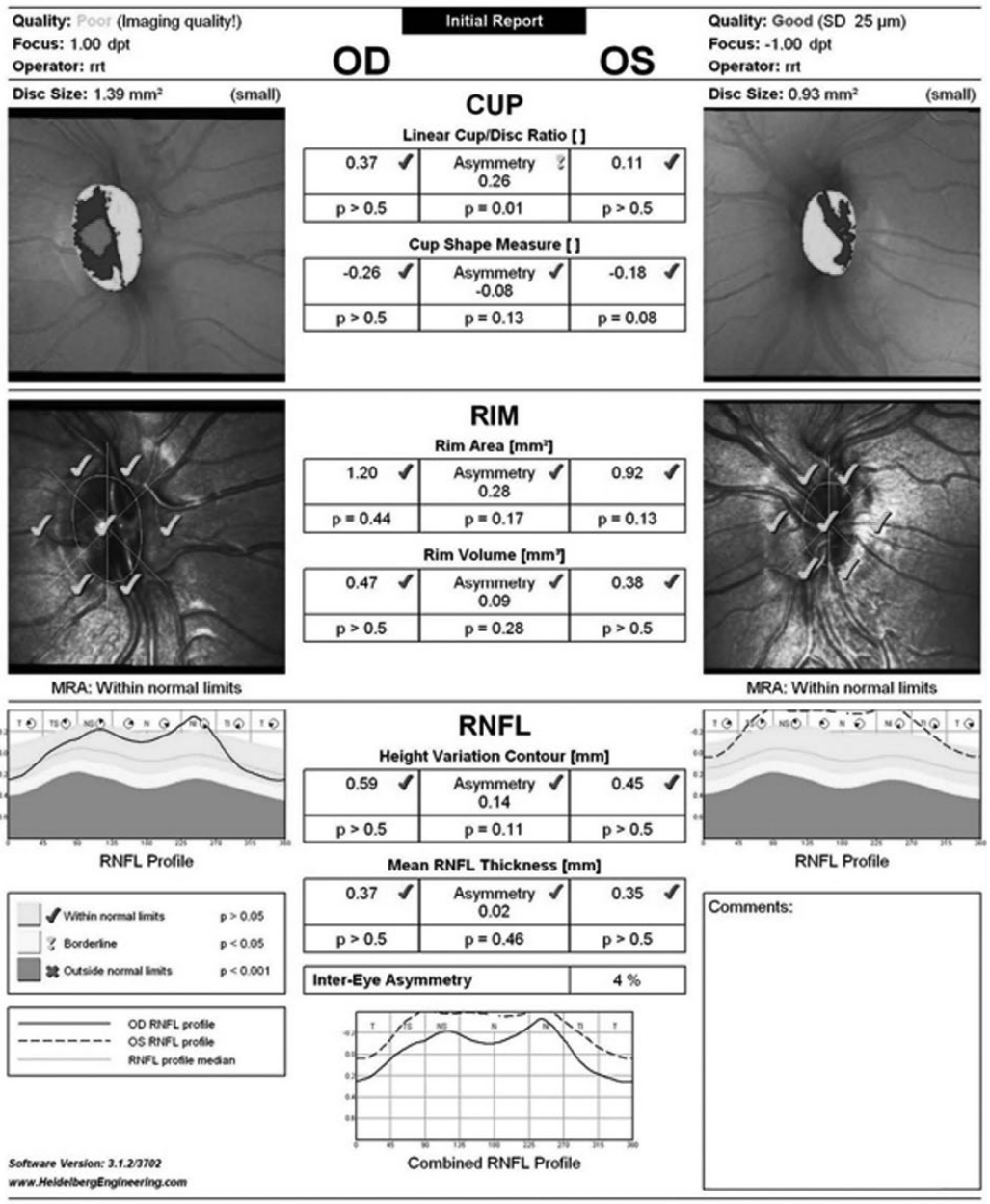

Figure 2: *HRT results for both eyes. Note substantially smaller disc area OS.*

Discussion

The normal range for disc area measured by HRT3 in Caucasian adults is 1.6-2.5 mm.[2] Although norms for HRT3 in Hispanic children and adults have not been established, there was a clinically significant difference in disc area between the two eyes of our patient (OD 1.39 mm^2, OS 0.93 mm^2) that was visible with ophthalmoscopy as well. Thus, HRT further confirmed that the nerve head OS was noticeably smaller than OD. A DM:DD ratio greater than approximately 3:1 has been shown to suggest ONH.[10,11] Based on the DM:DD ratio of 3.34 OS and the smaller disc area measured by HRT, we diagnosed our patient with ONH OS.

Our patient had less myopic anisometropia (spherical equivalent) than the expected minimum amount (3 D) that many clinicians consider amblyogenic based on the American Optometric Association's Optometric Clinical Practice Guideline on amblyopia.[3] Most patients with this amount of myopia in one eye would use that eye (unaided) for close work and the fellow eye for distance viewing, preventing the development of amblyopia. If ONH accounted completely for the reduced VA in our patient, the refractive error in the eye with ONH should have allowed her to use that eye for some close work activities, precluding relative amblyopia development. To determine whether her reduced VA OS was attributable solely to the ONH, spectacle correction of the full refractive error and patching were attempted. Treatment consisted of daily part-time direct occlusion along with monocular near activities, as has been found successful for treating moderate amblyopia.[9] Recent research has found that spectacle prescription wear alone produced VA improvement

in many children with amblyopia.[12,13] However, we desired to achieve potential VA improvement as quickly as possible and thus proceeded to add patching to spectacle wear. The fact that best-corrected VA improved from 20/100 to 20/40 suggested that a robust component of the VA loss was due to amblyopia. Based on the appearance of the hypoplastic nerve OS, it was not surprising that 20/40 was the best VA achieved. Fortunately, our patient has improved stereopsis, no strabismus, and her VA remains stable. She continues to wear polycarbonate spectacles to protect her eyes from injury and to correct her refractive error.

We are not aware of other published cases of ONH with amblyopia resulting from the amount of anisometropia in our patient. In considering the dual causes of reduced VA in our patient's affected eye, we have concluded that reduced vision from ONH likely led to suppression and development of unilateral myopia in that eye, as has been shown to occur in eyes with unilateral ocular anomalies that degrade visual input.[14-16] Subsequently, amblyopia developed, secondary to the suppression and myopic anisometropia.[17] The amount of myopia apparently was sufficient to cause relative amblyopia when superimposed on the reduced VA from ONH. Improvement in VA with treatment demonstrated that a large component of the vision loss could be attributed to amblyopia.

Although some have questioned the efficacy of treating concurrent amblyopia in cases of unilateral ONH,[18] treatment has been recommended by a number of authors.[19,20] Yang and Lambert[18] cautioned against treating children with long-term patching for presumed amblyopia without a correct diagnosis of an underlying ocular anomaly that actually caused the vision loss because they would not improve with patching. Certainly, a practitioner needs to be cognizant of all reasons for vision loss in a patient and should not subject patients to unnecessary occlusion treatment. In contrast, with proper diagnosis of a structural condition such as persistent hyperplastic primary vitreous, others have achieved some success in treating the amblyopic component of vision loss.[19] Indeed, Bradford et al.[20] found that 21% of patients with optic nerve anomalies achieved VA of 20/80 or better following full time occlusion for their concurrent amblyopia. They reported that strabismus and amblyopia were common in eyes with unilateral optic nerve abnormalities. They further suggested that occlusion was the best option for these patients potentially to improve their vision, even though many did not improve.[20]

Based on the success of our patient, we recommend that eye care practitioners attempt patching treatment for motivated patients with unilateral ONH even if an expected amblyogenic factor is not present, unless vision is too poor for the patient to comply. In our experience, many patients with reduced VA appreciate even partial improvement with treatment. Certainly, all patients should have the opportunity to wear a refractive correction in an attempt to achieve maximal VA. Protective eyewear is essential for patients with poor vision in one or both eyes even if VA does not improve in the eye with ONH. Initial amblyopic VA of poorer than 20/200 suggests that treatment success is less likely.[21] Some patients with severe vision loss cannot function with such impaired vision while the sound eye is occluded and understandably do not comply with patching treatment. If VA is poorer than approximately 20/400, only the most motivated patients might wish to undertake a trial period of patching. Based on data from other published case reports, we suggest patching for a minimum of three months if the patient is compliant before concluding that treatment is unsuccessful.[22] If there is improvement in VA, patching should continue until maximum VA is achieved.[4,23]

Conclusion

Our patient's vision in the eye with ONH improved from 20/100 to 20/40 with spectacles and patching treatment. We conclude that relative amblyopia had developed secondary to the myopic anisometropia and was amenable to treatment. Thus, we recommend that eye care practitioners attempt patching for motivated patients with unilateral ONH even if an expected amblyogenic factor is not present, unless vision is too poor for the patient to comply. A successful attempt to improve vision, even partially, in eyes with ONH may improve quality of life for these patients.

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