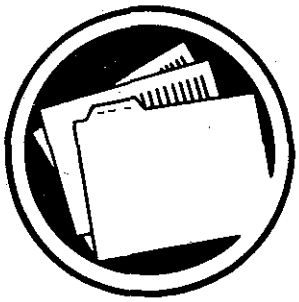

A Case In Point

Normal Stereo Acuity Despite Anisometropic-Amblyopia

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Introduction

An intriguing case of a patient who maintained normal stereo acuity despite severely reduced vision in his right eye (20/200) is presented. This case of uncorrected anisometropia combined with meridional amblyopia poses some interesting theoretical questions concerning the nature of stereo acuity and the parameters affecting it.

The effect of reduced monocular visual acuity on the ability to appreciate stereopsis in random dot stereogram (RDS) is controversial. Julesz[1] extensively blurred the RDS yet his subjects showed stereoscopic appreciation, suggesting that normal visual acuity is not essential for such appreciation. Reinecke and Simons[2] using the Random Dot E test had completely different findings. They found that more than two lines difference of acuity between the eyes or less than 20/40 in one eye is sufficient to fail the test (at a 900″ disparity level). They concluded, therefore, that the Random Dot E test can be used as a screening device for amblyopia. This conclusion was supported by Walraven[3] who used a tranaglyphic RDS (TNO test). In his study all the patients with reduced or questionable acuity failed the test; most at the 1980″ disparity level and the rest at the 240″ level. In a carefully controlled study using a 660″ random dot stereogram Cooper and Feldman[4] reported that five out of ten anisometropic amblyopes they examined passed the test and so did ten out of thirteen intermittent exotropes. They concluded that the RDS responses may be better explained in terms of bifoveal alignment than by visual acuity level. Therefore, its value as a screening for amblyopia is doubtful. Furthermore, Marsh et al.[5] compared the efficacy of RDE, Randot, Titmus, and the TNO tests as screening devices and found an under-referral rate of 33–37%, which they considered unacceptable.

In most of these studies disparities of greater than 500″ were used, with a range of 240″ to 3000″. These researchers were looking for stereo appreciation only; they did not try to evaluate the stereo acuity level (although they did report it in some cases). Stereo appreciation was felt by some to be affected by reduced visual acuity,[2,3] and believed not to be so affected by others.[1,4] Stereo acuity, however, was always thought to be dependent on monocular visual acuity. Levy et al.[6] used lenses to study the effect of reduced monocular acuity on stereo acuity. They found a linear relationship with stereo acuity of 80″ for 20/50 and 160″ for 20/200. Peters[7] studied the effect of anisometropia on stereo sensitivity—and found that four out of five subjects could not maintain stereopsis with 1.00 D of anisometropia.

In view of these conflicting results one would not be surprised to find some stereo appreciation in uncorrected anisometropic amblyopia with intermittent exotropia. However, normal stereo acuity (20″) would not be expected. Such a surprising case is presented here, and a possible explanation discussed.

Case presentation

Chief complaint and history

A 23-year-old male first year optometry student was seen at the college's general clinic for a routine checkup. The patient reported having amblyopia O.D. and having worn an eye patch during the first grade. There was no history of visual training or surgery. The patient was unable to use his right eye for retinoscopy and ophthalmoscopy and had some difficulty using the slitlamp in the preclinic lab. Spectacles were worn through elementary and high school. For the last four years, he has not used his glasses because he noted no improvement in vision when wearing them.

Diagnostic data

Visual acuity:

Unaided Snellen acuity at distance was:
R.E. 20/200
L.E. 20/15

At near (14″) reduced Snellen visual acuity unaided was:

R.E. 20/200
L.E. 20/20

Refraction:

Static retinoscopy showed:

R.E. +3.50 = −3.50 × 80 20/50
L.E. +0.25 = −0.50 × 30 20/20

Subjective exam revealed the following refraction:

R.E. +3.75 = −3.75 × 80 $20/50^{+1}$
L.E. plano = −0.50 × 150 $20/10^{-1}$

Eye Health:

Pupillary reflexes were normal. Intraocular pressure was 14 mm Hg in the right eye and 15 mm Hg in the left eye by non-contact tonometry. Slit lamp exam was unremarkable. Version movements were full and smooth into all nine directions of gaze. Color vision was normal in both right and left eye as measured on the Ishihara plates. Direct ophthalmoscopy was unremarkable in the left eye. A large chorioretinal scar (Fig. 1) measuring 3 × 2 disc diameters was noted less than one disc diameter temporal to the fovea of the right eye. The scar could be a result of toxoplasmosis-chorioretinitis. The patient reported having many cats in the house when he was a young boy.

Binocular vision:

Cover test revealed orthophoria at distance and 10△ right intermittent (50% of the time) exotropia at near. Central steady fixation was found on visuoscopy of both eyes. Near point of convergence was 4″ with a recovery of 6″. The patient reported diplopia when the right eye turned out during testing. At distance the patient had 3△ of exophoria with 1△ of right hyperphoria. At near he had 10△ of exophoria and no vertical phoria. On the vergence tests the patient suppressed his right eye or reported diplopia. Stereo acuity was measured with the Reindeer[a] test and a normal response (85%) was recorded with no optical correction. As such acute stereopsis was unexpected, further stereo acuity testing was performed. With the Titmus test stereo acuity was 40-seconds of arc (Circle #9). The Randot stereo acuity was measured at 20 seconds of arc. The patient demonstrated fine stereo acuity and correctly reported all of the different shapes on the Randot test. These stereo acuity responses were obtained with no correction and the visual acuity in the right eye was 20/200. When repeating the tests with the correction found in the subjective refraction (visual acuity $20/50^{+1}$) the patient responded more rapidly on all stereo tests used. The suppression control marks were seen intermittently on all tests, usually the right eye was suppressed.

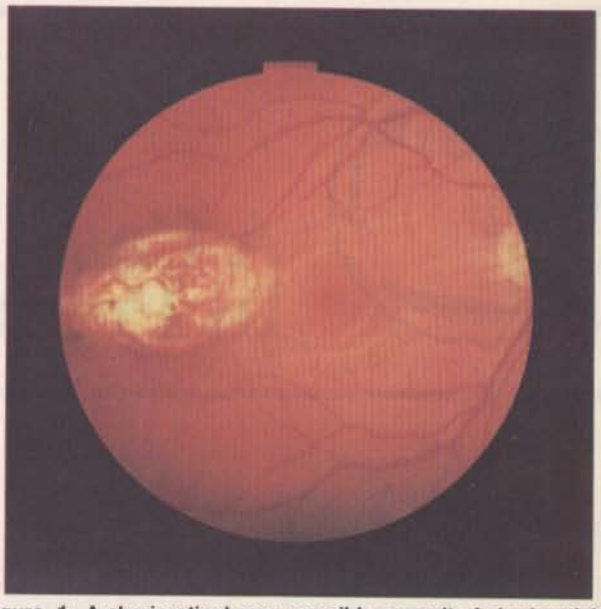

Figure 1: A chorioretinal scar, possibly a result of chorioretinitis due to toxoplasmosis, on the temporal side of the fovea of the patient's right eye.

Diplopia was reported with the Worth-4-Dot test at near (16″). Fusion was reported at a distance of one meter, and suppression of the right eye when the flashlight was taken to five meters. The Bagolini lenses test showed subjective angle of 10△, when the eye was deviated, suggesting normal retinal correspondence.

The reduced acuity was assumed to result from meridional amblyopia due to the astigmatic refractive error.[8] In order to test this I examined the patient's visual acuity for horizontal and vertical lines using the USAF 1951 Test Pattern.[b] The USAF chart consists of a stepped series of three bar patterns arranged together in orderly sequence. The patterns are paired in horizontal and vertical sets for every size. With full distance correction in place the patient could resolve the three bars for both vertical and horizontal at the bar size equivalent of 0.77 minutes of arc (20/15) with his left dominant eye. With the right amblyopic eye vertical lines were resolved at the level of 1.7 minutes of arc (20/34) and horizontal lines at 4.8 minutes of arc (20/96). As expected uncorrected vertical line resolution was not affected but horizontal resolving power was reduced significantly.

Discussion

In Cooper and Feldman's[4] study only 50% of anisometropic amblyopes passed the RDS at the 660″ disparity level and of these only one had acuity reduced as much as 20/80. How is it possible then, that our patient retains normal stereo acuity despite his reduced

monocular acuity? The type of refractive error in the amblyopic eye is hypothesized to be the reason. For a simple-hyperopic-astigmat against-the-rule the optics of the uncorrected eye form a clear image of vertical lines on the retina. Horizontal lines are imaged behind the retina, resulting in a blurred retinal image of these lines. This effect is due to the horizontal meridian of the eye being emmetropic while the vertical meridian is hyperopic. The same effects occur for near vision since the patient will use his left dominant eye to adjust his accommodation. Such astigmatic anisometropia is known to result in meridional amblyopia.[8] In our case we found the amblyopia to reduce the acuity for horizontal lines but to have minimal effect on vertical line acuity. Horizontal line acuity, however, has little value for stereopsis. Only the horizontal disparity of vertical image features between the two eyes is used for stereoscopic vision.[9] For the detection of such disparity vertical line acuity is required.

In a recent case report[10] another patient with astigmatic anisometropia was presented. This patient, however, was a hyperopic-astigmat *with-the-rule* in the right eye. Such refractive error will result in clear imaging of horizontal lines on the retina and blurring of vertical lines. Therefore, we would predict reduced stereo acuity. Indeed, this patient's stereo acuity was only 424 seconds of arc even when fully corrected with contact lenses to 20/30 Snellen acuity in the right eye and 20/20 in the left.[10]

The patient presented here has severely reduced visual acuity in the right eye and an intermittent exotropia. Such a patient should be easily detected by a screening for binocularity (RDS tests[2,3]). This case, however, supports Cooper and Feldman's opinion that these tests are insufficient for anisometropic amblyopia or intermittent exotropia, and are useful only for conditions where bifoveal fixation and sensory fusion are interrupted. Furthermore, it shows that in some cases not only stereo screening will fail but even stereo acuity tests are of no value in detecting anisometropic amblyopia. **AOA**

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FOOTNOTES

a. Bernell Corporation, South Bend, Indiana
b. Edmund Scientific Company, Resolving Power Chart No. 83001.

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