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Case report

Rapid neuroadaptation to surgically-induced aniseikonia in a 17-year-old patient with high preoperative anisometropia: A case report

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ABSTRACT

Purpose: To report a case of rapid neuroadaptation to surgically-induced aniseikonia in a 17-year-old with preoperative anisometropia of 9.5 D.

Observations: A 17-year-old female with a history of retinopathy of prematurity (ROP) and progressive high myopia with resulting anisometropia secondary to conventional laser photocoagulation in her right eye was found to have diplopia after undergoing cataract surgery in that eye. Other etiologies of diplopia were ruled out and reversal of anisometropia remained the only viable diagnosis. Her diplopia fully resolved without intervention within one month of the surgery.

Conclusion and Importance: In cases of neuroadaptation to long standing anisometropia, even if that anisometropia develops in infancy, abrupt reversal following surgery can be surprisingly well tolerated.

1. Introduction

Neuroadaptation has been a well-studied topic in the field of ophthalmology. Neural networks have classically been thought to be shaped at a young age during an early "sensitive period.[1]" Additionally, neuroadaptive responses have been suspected to deteriorate with age and become much less flexible after childhood.[2] However, there is building evidence that neuroplasticity, a term which refers to the brain's ability to alter the arrangement and function of connections with changing stimuli, in the visual system can persist into adulthood.[3,4] The concept of plasticity has significant impact on the correction of long standing ocular diseases. With the advent of intraocular lens (IOL) replacements and refractive procedures, operative changes to refractive errors and anisometropia have been made increasingly accessible. This report addresses the reversal of long-standing anisometropia in a teenager through cataract surgery and documents the course of her resulting diplopia and aniseikonia after correction. To the best of our knowledge, this is the first reported study documenting neuroadaptation to aniseikonia after IOL placement (based on an English-language PubMed search including "aniseikonia" AND "diplopia" AND "anisometropia" and "aniseikonia" AND "neuroadaptation" AND "anisometropia").

2. Case report

A 17 year-old female with a history of ROP and a myopic right eye as a complication of conventional laser treatment presented to our clinic in September 2016. She arrived with complaints of progressively blurry vision in the right eye accompanied by halos and glare over the last several months. Correction of refractive error with spectacles and contact lenses did not improve these symptoms.

The patient's birth history was significant for parturition at 28 weeks gestational age as a triplet, with birth weight of two pounds and four ounces. She suffered from a grade 2 intraventricular hemorrhage (IVH), was intubated for three weeks, and was on home oxygen for the first year of her life. Laser treatment was performed in her right eye at 3 months of age for stage III ROP in Zone II.

She has a past medical history of mild persistent asthma treated with albuterol on an as-needed basis and pneumonia in 1999 and 2000. She takes no other medications and has no allergies. Her past surgical history is significant for a tonsillectomy. Past ocular history is significant for coloboma of the left iris, small peripheral cataract in the right eye, and amblyopia of the right eye treated with patching 4 h daily as a child. There is also a family history of strabismus in both the patient's mother and father. Developmentally she has met all milestones and is doing well in school. She denied alcohol, tobacco, or recreational drug use and is not sexually active. She was up to date on her immunizations.

Best corrected visual acuity was 20/70-2 in the right and 20/20 in the left with no improvement on pinhole testing. Cover-uncover testing was unremarkable. Her pupils measured 4 mm–3 mm in the right eye and 5 mm–4 mm with an irregular pupil in the left eye. Intraocular

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pressures were unremarkable and external examination was within normal limits. Anterior segment exam revealed a central lamellar cataract encroaching on the visual axis in the right eye and an inferior iris coloboma in the left eye. Dilated fundus examination revealed normal, healthy appearing optic nerves bilaterally. Peripheral exam in the right eye was significant for 360° of laser scars, and a mild epiretinal membrane was noted in the macula in the right eye.

On review of records, the anisometropia had progressively worsened over the last ten years. Cycloplegic retinoscopy at 7 years of age showed −4.0–1.5 × 60 in the right eye and −0.75–0.75 × 70 in the left eye. At our clinic, manifest refraction was −8.75–1.75 × 60 in the right eye and +1.50–2.75 × 164 in the left eye. She has consistently worn spectacles since a young age and has not been able to tolerate contact lenses due to discomfort. Axial length measurements by optical biometry were 23.68 OD and 21.42 OS. The axial length asymmetry confirmed axial myopia as the cause of her myopia rather than the presence of the cataract. She also likely suffers from a mild degree of anisometropic amblyopia.

Cataract surgery was performed under monitored anesthesia care (MAC) and local anesthesia on November 2016. A 16.0 D ZCB00 lens from Abbott Medical Optics was placed in the capsular bag without complication.

One day after the operation, uncorrected visual acuity was 20/40 in the right eye. Slit lamp and fundus examination was unremarkable aside from mild cell in the right anterior chamber. Manifest autorefraction in the right was found to be +0.00–0.75 × 70. She was noted to have a new onset mild binocular horizontal diplopia in primary gaze. Cover-uncover testing was normal at near and distance, which ruled out strabismus and accommodative esotropia. The diplopia was thought to be due to aniseikonia, because she still had a difference in axial length and now had an intraocular lens inserted behind the anterior focal point of the eye (Knapp's Rule).[5]

At her one week follow-up, her uncorrected visual acuity was 20/30 in the right and the remainder of her physical examination was unchanged. At her one month post-surgery visit, her uncorrected visual acuity was 20/50 in the right eye and examination was remarkable for a 2 + posterior capsular opacity (PCO) in the right eye. The diplopia evident one month earlier was no longer present.

She underwent a YAG laser capsulotomy of the right eye on February 2017. Visual acuity was 20/30 in the right eye and 20/20 in the left eye two weeks after the procedure without diplopia.

3. Discussion

In this report, we present a case of chronic anisometropia as a complication of laser treatment for ROP during infancy. While anisometropia may lead to aniseikonia, our patient did not experience a significant difference in perceived image size during early life because of Knapp's Rule.[5] Knapp's Rule states that aniseikonia does not occur with severe axial anisometropia when corrected in the spectacle plane. As our patient was spectacle corrected, she was able to tolerate a sizable power difference of 9 diopters between both eyes up until cataract extraction. It is worth mentioning that the clinical application of Knapp's Rule is limited. Purely axial anisometropia is rare and is often combined with refractive anisometropia (corneal or lenticular).[5–7] Her aniseikonia post-operatively could be explained by a still present difference in axial length and placement of an intraocular lens posterior to the spectacle plane. Fortunately, she retained a significant degree of neuroplasticity at the age of 17 and was able to neuroadapt to the aniseikonia induced by the cataract surgery within one month.

Of note, several papers have been published about the utilization of IOLs in the reversal of myopic anisometropia in the pediatric population.[8,9] These studies have shown improvements in visual acuity and regression of amblyopia even in patients beyond the ages considered to be responsive to anti-amblyopic treatment[8] While the patients in these papers had axial anisometropia much like our own, no mention of aniseikonia was noted.

4. Conclusion

In conclusion, we found that reversal of chronic anisometropia of roughly 9 diopters resulted in primary gaze diplopia that was present immediately after correction through placement of a posterior chamber IOL. We suspect that aniseikonia did not exist in early life despite a large degree of axial ametropia because of Knapp's Rule. The complaint of double vision post-operatively was likely an aniseikonia that manifested after cataract surgery. We suggest that this aniseikonia was overcome through a surprisingly effective degree of neuroplasticity in this 17-year-old patient, leaving her asymptomatic within 1 month of surgery.

Patient consent

This report does not contain any personal information that could lead to the identification of the patient.

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Conflicts of interest

All contributing authors declare no financial disclosures or conflicts of interest.

Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

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