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The Value of Serial Personal Photographs in Timing the Onset of Unilateral Cataracts in Children

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Abstract

Purpose—To determine the value of serial personal photographs in timing the onset of unilateral cataracts in children over 6 months of age.

Methods—Personal photographs from 11 children with unilateral cataracts who underwent CE and IOL implantation when ≥ 6 months of age were reviewed. Photographs were evaluated for changes in the red reflex which might indicate the presence of a cataract.

Results—The children underwent cataract surgery at a mean age of 40.3 months. They were followed for a mean of 33.2 months. Nine children were diagnosed as having an acquired cataract by photographic review documenting a previously normal red reflex. The visual acuity in the affected eye of 4 of these 9 children improved to $\geq 20/60$.

Cataracts were visible on photographs prior to clinical diagnosis in 5 patients, from 0.5 to 22 months prior to clinical diagnosis, but visual outcomes were not correlated with the photographically documented duration of the cataract prior to treatment.

Photographs were not helpful in timing the onset of cataract in two children due to the poor quality of the images.

Conclusions—Serial personal photographs are helpful in determining whether cataracts are acquired. However, they have limited usefulness in predicting the visual outcome presumably because other factors such as compliance with patching therapy are also critical in achieving good visual outcomes.

Introduction

Delays in cataract surgery can result in dense, irreversible amblyopia in young children.^{1, 2} In many cases, when a child presents with a unilateral visually significant cataract it is not known how long the cataract has been present.^{3–5} If the age of onset could be ascertained with some degree of certainty, parents could be better informed about the visual potential of the eye, and would be in a better position to make a decision as to how to proceed with treatment. Most parents would likely choose to proceed with cataract extraction even if the prospect for visual

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Conflict of interest: none

improvement was small. However, in some instances a parent might decide against cataract surgery if the potential benefits did not appear to justify the risks and costs.

With the advent of digital photography, children are being photographed more frequently by their parents. Often these photographs are taken with cameras built into cellular telephones that parents carry with them at all times. Other sources of photographs are the parent's "my space" or "facebook" websites, which can be reviewed while the patient is in the office. These photographs provide an important historical record of the maturation of these children.

Photographs have been shown to be helpful in the management of a variety of ocular diseases. For example, serial personal photographs have been employed in the diagnosis, evaluation, and management of superior oblique palsies and are especially helpful in differentiating congenital from acquired palsies by documenting the presence of a head tilt.⁶⁻⁸ A patient with a longstanding head tilt is often managed differently than a patient with the recent onset of a superior oblique palsy. Similarly, photoscreening has become a widely accepted method of screening children for high refractive errors, strabismus, and can clearly identify media opacities.^{9, 10}

We retrospectively reviewed serial personal photographs from a consecutive series of young children with a newly diagnosed unilateral cataract to determine their value in timing the onset of cataract formation.

Materials and Methods

This study was approved by the Emory University Institutional Review Board and is in compliance with the Health Insurance Portability and Accountability Act. Data were gathered by a retrospective review of the medical records of all patients six months to seven years of age with a newly diagnosed unilateral cataract who were treated at the Emory Eye Center between 2002 and 2009. Exclusion criteria included children with known congenital or traumatic cataracts, associated ocular diseases such as uveitis and glaucoma, posterior segment pathology, and retinopathy of prematurity or systemic disorders.

All patients underwent unilateral cataract extraction with intraocular lens implantation. Spectacles were prescribed once the refractive error in the operated eye had stabilized. Parents were asked to patch the unaffected eye on a part-time basis based on the age of the child and the severity of their amblyopia. Patching compliance was assessed by parental report during follow-up examinations. Patching compliance was graded until age 7 years in the following manner: excellent, ≥ 4 hours/day; good, 2–4 hours/day; fair, 1–2 hours/day; poor, < 1 hour/day. Spectacles were prescribed to correct residual refractive errors in the pseudophakic eye as well as large refractive errors in the fellow eye. A bifocal correction was prescribed for the pseudophakic eye in children 2 years of age or older, and children under age two were corrected to be in focus at near with single vision lenses. Spectacle compliance was assessed by parental report during follow-up examinations. Spectacle compliance was graded in the following manner: excellent, spectacles worn during all waking hours; good, spectacles worn the majority of each day; fair, spectacles worn part of each day; poor, spectacles worn infrequently or never. Optotype visual acuity was assessed using HOTV letters in young children and a Snellen eye chart in older children. Young children were refracted using retinoscopy and older children using a Nidek ARK-700A autorefractor (Nidek, Hiroshima, Japan). Ocular alignment was measured using the prism and alternate cover test with distant fixation targets.

Data and Photographic Analysis

For each patient, data were collected on the morphology of the cataract as determined at the time of surgery, preoperative biometry, oculomotor alignment, age at the time of cataract

surgery, patching and spectacle compliance, and pre and postoperative best corrected visual acuities.

The authors reviewed serial personal photographs of the patients taken prior to cataract extraction. All photographs were dated and thus could be correlated with patient ages. In some cases, original copies of photographs were submitted by families for review whereas in others digital copies were either e-mailed to the author or submitted on a compact disc. All photographs were taken in the undilated state. Prior to evaluation, all photographs were converted to a digital format. Digital formatting was then used to enhance the visualization of the pupillary red reflexes and media opacities. All photographs were analyzed independently by two of the authors to ensure inter-observer agreement. Photographs were evaluated for the presence of a cataract using the criteria listed in Table 1. A cataract was said to be present if at least one criterion was identified. If a cataract was diagnosed by serial personal photographs, the age of cataract onset was recorded as the age of the child when the cataract was first visible on photographs. The age a cataract was diagnosed clinically was the age at which an ophthalmologist first diagnosed a visually significant cataract.

Results

Twelve patients (5 males and 7 females) met the eligibility criteria for the study, however one child was not enrolled in the study because all photographs of him were destroyed in a house fire. The clinical features and visual outcomes of the 11 enrolled patients are outlined in Table 2. Ten patients were white and one was black. Patients underwent unilateral cataract extraction at a mean age of 40.3 months (range, 8 months to 7.5 years). The mean postoperative follow-up was 33.2 months (range, 1 month to 6.6 years). All of the patients had an intraocular lens implanted at the time of cataract surgery. Four patients had strabismus preoperatively. All patients had normal fellow eyes.

The number of photographs evaluated for each patient ranged from 3 to 19 (mean, 8.5). Red reflexes were only visible in 43 of the 93 (46%) submitted photographs. Photographs were helpful in timing the onset of cataracts in 9 of the 11 patients (Table 3). In nine patients, personal photographs documented a previously normal red reflex, and in 5 of these 9 patients, subsequent photographs documented the presence of a cataract 0.5 to 22 months before it was detected clinically (Figures 1–2). Visual outcomes of eyes with photographically documented acquired cataracts ranged from 20/25 to 20/400 with 4 of the eyes having visual outcomes of 20/60 or better (Table 2). Small numbers precluded statistical comparison with eyes in whom acquired cataracts could not be documented photographically. There did not appear to be a trend of improved visual outcomes in eyes with photographically documented shorter duration of untreated cataract; however, differences in compliance with spectacles and patching did appear to be important. Three of the four patients with visual outcomes of 20/60 or better had fair, good or excellent patching compliance whereas all of the other patients had poor patching compliance. Finally, there were two patients in whom personal photographs were not helpful in timing the onset of cataract because adequate photographs could not be obtained.

Of the 9 patients with photographically documented acquired cataracts, 6 were classified as posterior lentiglobus, 1 as total, 1 as lamellar and 1 as posterior subcapsular. The remaining 2 cataracts whose onset could not be documented photographically were classified as lamellar and nuclear.

Discussion

We found that personal photographs were helpful in determining whether a unilateral cataract was acquired in 9 of 11 cases. Four of the children who were shown photographically to have

an acquired cataract achieved visual acuities of $\geq 20/60$. In all instances, parents were willing to share personal photographs to help in determining the age of onset of their child's cataract.

The utility of photography to identify lens opacities is well known. Photoscreening employs specialized cameras that take off-axis photographs of the red reflex to optimize the identification of lens opacities, but it is not yet in widespread use.^{11, 12, 13, 14} In contrast, amateur personal photographs are widely available but they have limitations in their ability to diagnose cataracts. First, personal photographs often do not show the ocular red reflexes either because the cameras have a red eye reduction feature or because the photographs are taken outdoors while the pupils are miotic. Second, personal photographs may be associated with artifacts of the red reflexes, which may be confused with abnormalities arising from ocular disease. For example, an indoor photograph taken 15 degrees off axis using flash illumination may have the appearance of unilateral leukocoria.¹⁵ This artifact is believed to arise from light reflecting off of the optic disc. In most cases, this abnormality is only noted in isolated photographs. In contrast, changes in the red reflex arising from ocular disease are consistently present and they usually reduce the brightness of the red reflex as well.

The major problem we encountered in our study was an inability to detect the red reflexes in the majority of the personal photographs submitted for review. The red reflex could not be seen for a number of reasons. In the photographs that were taken outdoors, the miosis induced by sunlight generally precluded seeing red reflexes. All of the informative photographs in our study were taken indoors using flash photography. Another common problem was that many photographs were taken using cameras equipped with a red eye reduction feature. This was the case for all of the photographs taken by the parents of Patient 10. Fortunately, the grandparents' cameras did not have this feature so we were able to evaluate this child's red reflexes by reviewing photographs they had taken. In other cases, the photographs were poorly focused or the eyes were too minified to be able to see the red reflexes clearly even after digital enhancement and enlargement. We were unable to identify the red reflexes in any of the photographs submitted by the parents of the only African American child in our study. This was likely due to the fact that it is generally more difficult to see red reflexes in patients with darkly pigmented eyes. Red reflexes were difficult to identify in most of the photographs taken of children who looked directly at the camera. The most informative photographs were taken with children looking eccentrically. All of the professional photographs we reviewed were not informative presumably because they were taken on-axis with a camera equipped with a red eye reduction feature.

It has been proposed that the most important determinate of the long-term visual outcome of pediatric cataract surgery is the type of cataract.¹⁶ The two types of pediatric cataracts that have been reported to be associated with the best visual outcomes are lamellar and posterior lentiglobus cataracts. The better visual prognosis associated with these types of cataracts is attributed to the fact that they are generally acquired after birth. However, not all children with these types of cataracts have a good visual outcome suggesting that a delay in treatment can still adversely affect the visual outcome. While on occasion posterior lentiglobus presents as a visually significant cataract at birth, more commonly it presents as an abnormal red reflex resembling an "oil droplet" during infancy that evolves over months or years into a visually significant cataract.^{17, 18} Parks reported that while the median visual acuity was between 20/50 and 20/60 for 33 children with posterior lentiglobus following cataract surgery, 14 of these eyes had a visual outcome $\leq 20/100$.¹⁶ The poor visual outcome in some of these eyes may have been secondary to the development of amblyopia during the time interval between the cataract and surgery. It is likely that other factors also affected the visual outcome such as patching and contact lens compliance. Six of the patients in our series had posterior lentiglobus and two had lamellar cataracts. While the visual outcome was $\geq 20/60$ in 3 of these eyes, the visual outcome was $\leq 20/100$ in the other 4 eyes (one of our patients with posterior lentiglobus,

patient 11, did not have sufficient follow-up to determine the visual outcome) suggesting that the morphology of a cataract alone is not always predictive of the visual outcome.

The visual results reported following cataract surgery for children with cataracts of indeterminate age have been quite variable. Kushner reported that the visual outcome in the affected eye was 20/50 or better in 14 of 17 children who underwent unilateral cataract surgery between 1 to 5 years of age.⁴ However, he excluded from his analysis 8 children with microphthalmos. In contrast, Wright and colleagues reported a visual outcome >20/200 in only 3 of 10 patients who underwent unilateral cataract surgery between 1 to 5 years of age.³ The patients in their series primarily had posterior lentiglobus and posterior subcapsular cataracts. Our visual results are not as good as those reported by Kushner, but are similar to those reported by Wright and colleagues. All of the children in our study were pseudophakic and wore spectacles to correct their residual refractive error. Although most children were compliant with spectacle wear, compliance with patching therapy was poor in 8 of the 11 patients.

Our study had a number of limitations. First, the number of patients in the series was quite small. With a larger series it may have been possible to better correlate the visual outcomes with the length of time that elapsed between the photographic identification of a cataract until cataract surgery was performed. In particular, it would have been helpful to have been able to include more non-Caucasian patients in our study so we could evaluate the feasibility of using serial personal photographs to detect cataracts in these children. Second, the follow-up period for our patients following cataract surgery was relatively short. With a longer follow-up, the visual outcome may have been better for some patients since most of these patients are still undergoing amblyopia therapy. Third, it would have been helpful to have provided parents with more guidance as to which types of photographs would be most informative. As the study progressed and we gained more experience in reviewing photographs, we were able to give parents better guidance as to which types of photographs would be most helpful to review. As a result, the quality of the photographs submitted improved.

Many parents were able to recognize the cataract in their child's eye in photographs after we showed them examples of cataracts in other patient's photographs. However, none of the parents were aware of the presence of abnormal red reflexes in personal photographs of their child until we asked them to review them. Improved public education on the importance of children having normal red reflexes may allow parents to detect cataracts at an earlier age.

In conclusion, in many cases serial personal photographs can be helpful to determine whether a unilateral cataract in a child is acquired. Photographs can also be helpful in determining the period of time that elapsed from the onset of the cataract until cataract surgery is performed. We recommend that ophthalmologists review serial personal photographs of children with unilateral cataracts prior to performing cataract surgery to better inform parents of the visual potential.

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Figure 1. Patient 1 with leukocoria. (Left) Off-axis photograph of patient at 13 months of age. A red reflex is visible in the right eye. A red reflex is present in the left eye as well, but is difficult to see because of the poor quality of the picture. (Right) On-axis photograph of patient taken 3 months later. Leukocoria is now present in the right eye.

Figure 2. Patient 5 with posterior lentiglobus. (Left) Off-axis photograph of patient at 2 months of age. There is a slightly attenuated red reflex in the right eye. This finding is consistent with the “oil droplet” stage of posterior lentiglobus. (Right) On-axis photograph of patient at 3 months of age. There is a visually significant cataract in the right eye.

Table 1

Criteria for Diagnosing a Cataract using Serial Photography

1	Absence of the red reflex in one eye compared to a normal red reflex in the contralateral eye.
2	Inequality in color, intensity or clarity of the red reflex between eyes.

Table 2

Clinical Characteristics of Patients

Patient #	Gender	Race	Age at surgery (mos)	Diagnosis	Affected eye	Preoperative		Postoperative		Optical Treatment		
						Operative Eye (BCVA)	Operative Eye (BCVA)	Operative Eye (BCVA)	Maximum Follow-up (mos)	Correction Worn	Compliance	Patching Compliance
1	M	White	17	posterior lentiglobus	OD	NC S NM		20/400	23	Spectacles	Excellent	Poor
2	F	White	53	posterior lentiglobus	OD	CF		20/60	29	Spectacles	Poor	Poor
3	M	White	76	posterior lentiglobus	OS	20/200		20/100	17	Spectacles	Poor	Poor
4	F	White	78	posterior lentiglobus	OS	20/250		20/60	17	None	N/A	Fair
5	F	White	8	posterior lentiglobus	OD	NC S NM		20/30	79	Spectacles	Excellent	Excellent
6	F	White	20	lamellar cataract	OS	NA		20/125	21	Spectacles	Excellent	Poor
7	F	Black	90	nuclear cataract	OD	CF 3'		20/400	8	Spectacles	Poor	Poor
8	F	White	30	total cataract	OS	C S NM		20/400	60	Spectacles	Excellent	Poor
9	M	White	52	posterior subcapsular cataract	OS	CF 5'		20/50	74	Spectacles	Excellent	Good
10	M	White	9	lamellar cataract	OD	NC S NM		20/400	36	Contact Lens	Excellent	Poor
11	F	White	10	posterior lentiglobus	OD	C S NM		N/A	1	Spectacles	N/A	N/A

BCVA, best corrected visual acuity; CSM, central, steady and non maintained; C S NM, central, steady and not maintained; CF, count fingers; N/A, not available