Comparison of the effectiveness of a nondilated versus dilated fundus examination in the pediatric population

Maria L. Parisi, O.D.a  
Mitchell Scheiman, O.D.a  
Rachel S. Coulter, O.D.a

The debate about whether to perform pupillary dilation on a routine basis continues to be discussed in the optometric literature. It is suggested that many optometrists do not use pupillary dilation on a routine basis. A 1989 survey of 259 optometrists found that only 6 percent of respondents routinely used dilation. Siegel and colleagues have extensively reviewed the arguments for and against routine dilation and the standard of care issues involved. Common reasons cited for not using dilation on a routine basis include time constraints, patient reluctance, concerns over inconvenience, ocular and systemic side effects of diagnostic agents, and low incidence of peripheral disease in asymptomatic patients, especially in the pediatric and young adult healthy population. Reasons to perform routine dilation include inability to assess the peripheral retina with a nondilated examination, enhancement of the detection of posterior pole disease, concern that patients may develop disease between examinations, concern over the legal ramifications of missed lesions, and adherence to a medical standard of care.

It is well known that diagnostic agents may cause systemic and ocular side effects. Yet the incidence of such adverse effects has been found to be less than 0.208 percent in a study of 12,493 drug applications involving patients from birth to more than 90 years of age. Yolton and colleagues study of 15,000 applications of diagnostic pharmaceutical agents to subjects ranging from newborns to adults in excess of 61 years of age found no reported cases of systemic side effects, while ocular side effects were transitory and self-resolving. Both premature and full-term infants may experience increased adverse reactions and absorption of drugs due to lower body mass, smaller blood volume and immature cardiovascular and nervous systems. Concern regarding patient drug side effects may further deter routine dilation of asymptomatic infants and children. Even so, it may be argued that usage of the lowest dose and volume of drug will help prevent side effects and obtain the desired degree of dilation and cycloplegia.

With regard to the low incidence of peripheral disease, Siegel and colleagues in a study of 500 adult subjects aged 20 years and older, found...
57.4 percent had peripheral anomalies that would have been missed if the patient had not received a dilated fundus examination; 20 of the peripheral anomalies required immediate action. This study also found that 51 percent of posterior pole lesions were not detected with a nondilated pupil examination and that 38 percent of the posterior pole lesions that required immediate action were not detected with a nondilated pupil examination.

The argument has been made that patients need not receive pupillary dilation if they are asymptomatic or unless they have definite indications for dilation. Yet, Siegel and colleagues found in their adult study that 14 percent of the anomalies that required action were asymptomatic. Silverman described two cases of asymptomatic patients age 18 and 55 years who received routine pupillary dilation and were found to have a small rhegmatogenous detachment and a choroidal melanoma, respectively. Likewise, selective dilation of only symptomatic pediatric patients has been the subject of legal opinion, most notably in the case of Keir v United States. This case suggests that optometrists will be judged according to a medical standard of care and that optometrists should routinely screen for peripheral disease regardless of previous normal fundus examinations, family history, associated systemic or ocular disease, or presenting signs and symptoms.

To investigate these issues in a pediatric population, a study was undertaken to determine the effectiveness of a nondilated retinal examination as compared to a dilated examination. Although a similar study has been performed in the adult population, to date no comparable study has been performed in the pediatric population. The adult study established that a dilated fundus examination was more effective in detecting posterior pole and peripheral anomalies, that symptoms were not always reliable indicators for retinal disease, and that retinal anomalies had a relatively high incidence. Using methods that were similar, the effectiveness of a dilated fundus examination was compared to the effectiveness of a nondilated examination by comparing the number of posterior pole anomalies found with each technique, and determining the number of peripheral anomalies found with the dilated examination that were missed with a nondilated examination.

### Methods

**Subjects**

The population consisted of 90 pediatric patients aged 5 to 16 years (mean age 9.2 years). Subjects were selected randomly from

### Table 1

<table>
<thead>
<tr>
<th>Anomaly</th>
<th>Lesions Detected</th>
<th>Lesions Missed by Natural Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retinal pigment epithelial dots/spots</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Retinal pigment epithelial dropout</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Tilted disc</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Posterior staphyoma</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Situs inversus</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Choroidal and scleral crescents</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Preppapillary vessel loop</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Macular drusen</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Macular pigment dot</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Isolated posterior pole drusen</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Optic nerve glial remnants</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Tortuous blood vessels associated with prematurity</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Bear track</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Toxocara canis lesion</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Chorioretinal scar</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Choroidal nevus</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*Multiple occurrences of an anomaly in the same patient were counted once.*
the clinic population presenting for a pediatric eye examination at The Eye Institute of the Pennsylvania College of Optometry. Patients who present to this clinic are randomly assigned to the examining practitioners without consideration of history, chief complaint, sex or ethnic background. During the course of multiple clinic sessions, the patients randomly assigned to the authors were utilized as subjects. Fifty-three percent of the subjects were male. Seventy-three percent of the subjects were black, 21 percent were white, 3 percent were Hispanic, 1 percent were Pakistani and 1 percent were Eastern Indian.

**Procedures**

Direct ophthalmoscopy was performed on each patient before pupillary dilation, while direct and binocular indirect ophthalmoscopy were performed post-dilation. The drops were administered with the standard technique of instillation in the lower cul de sac or filling the medial canthus with the eyes closed and then allowing the eyes to be opened following instillation. The assistance of a parent or student intern was used when necessary to guide the patient's fixation for both the nondilated and dilated examination. Scleral depression was utilized when indicated. One practitioner performed the nondilated retinal examination while the other performed the dilated retinal examination without knowledge of the previous examiner's findings. Dilation was achieved with the use of one drop of an anesthetic, one drop of 1% tropicamide and one drop of 2.5% phenylephrine in each eye. Twenty-one percent of the patients required a cycloplegic examination, requiring 1% cyclopentolate to be added to the regimen or substituted for the tropicamide. Three percent of the patients required an additional drop of tropicamide or phenylephrine because of inadequate dilation. Two patients received only 1% tropicamide by oversight.

**Results**

Twenty-three patients (25.5 percent) had one or more posterior pole anomalies that were not detected through the nondilated pupil examination (Table 1). A total of thirty posterior pole anomalies were not detected by the nondilated examination. Widely accepted criteria were used to determine which lesions had the potential for future complications. Of the posterior pole anomalies not detected by the nondilated examination, the only anomalies with potential for future complications were the chorioretinal scar, posterior staphyloma, macular drusen and choroidal nevus. None of these anomalies needed immediate referral or treatment and all findings required only routine monitoring. Of the posterior pole anomalies detected by both techniques, only the toxocara canis lesion required immediate referral to a retinal specialist due to peripapillary traction and risk of macular detachment. The retinal specialist recommended photographs, close monitoring and vitrectomy if the traction showed progression. Vitreous liquefaction was noted with the nondilated examination in one subject, but was not observed during the dilated examination.

Forty-six patients (51 percent) had one or more peripheral anomalies not detected through the nondilated pupil examination. A total of 69 peripheral anomalies were not detected by the nondilated examination (Table 2). To determine which peripheral anomalies had the potential for future complications, widely used criteria were established and divided into three categories (Table 2). In establishing the categories, adult guidelines were used for those disorders in which the prognosis was not specific to children. It might be assumed that there is a better prognosis in the pediatric population due to less time for vitreoretinal degeneration, yet environmental factors such as increased physical activity and trauma may be influential.

The first category included conditions generally considered to be benign at any age. Thirty-five benign peripheral lesions (51 percent of all peripheral anomalies), involving 30 patients, were detected. The second category included conditions that generally require routine or periodic monitoring, with emphasis on education about the signs and symptoms of progressive disease. Twenty-four peripheral lesions (35 percent of all peripheral anomalies), involving 19 patients, were detected in the second category.

The third category included conditions that generally require close monitoring, referral to a retinal specialist, systemic work-up, treatment,
or possess additional risk factors\textsuperscript{18} for retinal detachment.

The risk factors specific to the pediatric population considered in this study included vitreous degeneration in the form of vitreous liquefaction or shrinking, patients with myopia over 3 diopters, patients with a strong family history of retinal detachment and patients with symptomatic breaks.\textsuperscript{18} In category three, 10 peripheral lesions (14 percent of all peripheral anomalies), involving eight patients, were found. Of these, only four lesions (5.8 percent), involving three patients, required treatment or systemic work-up. One patient required laser barrier treatment for localized retinal detachments secondary to both an operculated and an atrophic hole, one patient required a systemic work-up for pars planitis and another patient required a systemic work-up for venous sheathing.

Sixty-five subjects (72.2 percent) had one or more posterior pole or peripheral anomalies. Multiple areas of an anomaly within the same patient, such as multiple areas of white without pressure, were counted as only one anomaly.

Seven subjects (7.7 percent) were noted to be uncooperative for binocular indirect ophthalmoscopy. Two subjects (2.2 percent) had a suspected lesion at the ora serrata that could not be viewed with scleral depression due to lack of cooperation, even though the subjects were otherwise cooperative for binocular indirect ophthalmoscopy. The macula could not be viewed with a nondilated pupil examination on one subject with high myopia due to the refractive error and lack of cooperation.

The percentage of anomalies were almost evenly distributed among the races in comparison to their contribution to the study population. Black subjects (73 percent of subject population) contributed 77 percent of the retinal anomalies while white subjects (21 percent of subject population) contributed 14 percent of the retinal anomalies. The Hispanic (3 percent of subject population), Pakistani (1 percent of subject population) and Indian (1 percent of subject population) subjects contributed 4.7 percent, 1.9 percent and 1.9 percent of retinal anomalies, respectively. The type of lesions found—in particular, white without pressure—may have been influenced by the population bias for black subjects. In fact, no white subject presented with white without pressure. Of the subjects in category three, six were black (75 percent), one was white (12.5 percent) and one was Indian (12.5 percent). The only subject who required treatment was white.

**Discussion**

In this study a dilated fundus examination provided a more effective method than a nondilated fundus examination to evaluate the posterior ocular health in a pediatric population. The dilated retinal examination detected more posterior pole anomalies than the nondilated retinal examination, and there was a high incidence of peripheral anomalies detected.

In addition, these findings seem to refute many of the arguments and concerns against routine pupillary dilation. With regard to the low incidence of peripheral disease in the pediatric population, it was found that 19 subjects (21 percent) required routine or periodic monitoring of lesions and education about signs and symptoms of progression. Eight subjects (8.8 percent) required close monitoring, referral, treatment or systemic work-up. It should be emphasized that, despite the high number of peripheral anomalies detected, only one subject (1.1 percent) required treatment and only two subjects (2.2 percent) required a systemic work-up. The sample size was too small to determine the incidence of specific retinal diseases in children; this consideration should be addressed in future studies.

The assumption that asymptomatic pediatric patients rarely have retinal disease may also be questioned by the study findings: Although only one patient was symptomatic, there was a high incidence of peripheral anomalies. All of the asymptomatic lesions required only monitoring, however, and it may be argued that it is unnecessary and time-consuming to examine for lesions that rarely need treatment. Yet, advocates of preventive health care may consider the ability to educate parents and children about the signs and symptoms of progressive disease, to provide recommendations for routine monitoring of ocular health, and to prescribe protective eyewear (when appropriate) an important part of primary care optometry. It may also be argued that a dilated examina-
tion with binocular indirect ophthalmoscopy may be more appropriate in the asymptomatic pediatric population than in the asymptomatic adult population because children may not report symptoms or inaccurately express subjective complaints. In fact, the symptomatic patient in this study localized the symptoms to the unaffected eye.

Following the administration of one drop of an anesthetic, 1% cyclopentolate and 2.5% phenylephrine in each eye, the symptoms resolved before the dilated fundus examination was performed. It is questionable if the symptoms were secondary to the ocular drugs since the patient appeared apprehensive in anticipation of receiving eye drops, struggled with the administration of the eye drops, and experienced the symptoms immediately following instillation. An emotional component may have been causal or contributory to the symptoms. No other ocular or systemic adverse reactions were reported.

The rarity of adverse reactions associated with diagnostic drug use flies in the face of hesitation to use these agents for routine examination (except when contraindicated in an individual patient). Of course, optometrists should always be prepared to manage ocular or systemic side effects of drug use and should use proper judgment on dosage.

Time constraints may be a clinical consideration, especially in a pediatric population, because of poor cooperation. The pediatric dilated fundus examination may at times require alteration of drug instillation procedures. In uncooperative pediatric patients it may be helpful to use a spray technique. It can be very time-consuming to perform binocular indirect ophthalmoscopy when the child is resistant to looking in the directions of gaze required to view the retinal periphery.
For many of the patients in this study the assistance of a parent or a student intern was used to guide the patient's fixation in the appropriate positions of gaze. With this assistance the peripheral retina could be viewed without difficulty in 92 percent of the patients studied. The high percentage of missed posterior pole anomalies without dilation may have been partially due to difficulty in maintaining the child's fixation, which is critical with a small pupil. In the pediatric population, it is more effective and may be more time-efficient to perform a dilated fundus examination because fixation is not as critical when the pupils are large.

Patient reservations and inconvenience have often been expressed as concerns. No parent in this study refused dilation. In a pediatric population there is little concern about risk of injury after dilation, as opposed to an adult population where there is risk of injury after dilation while driving or operating machinery. When necessary, a child may return to school with instructions for the teacher regarding visual limitations. If the child must return to school for a written test or sports activity, the dilated fundus examination may be rescheduled for a day or time that is more convenient.

The optometrist must also consider the legal risks of not performing a dilated retinal examination with binocular indirect ophthalmoscopy. Optometrists have been held legally responsible for the failure to diagnose ocular pathology in young patients. The standard of care to be applied in such cases is likely to be medical, as has been demonstrated in the case of Keir v United States and in other cases. A recent study recommends that pediatricians examine newborns through a dilated pupil shortly after birth to promote early intervention for ocular disease and avoid delay of visual stimulation during the critical period. If it becomes the standard of care for pediatricians to use dilated fundus examinations on healthy newborns, it will become difficult for optometrists to justify not using pupillary dilation on a routine basis.

A limitation of this study is the bias toward black subjects. As discussed in the results, the percentage of anomalies was almost evenly distributed among the races in comparison to their contribution to the study population. But racial bias may influence the type of lesions detected, as reflected for example by the high incidence of white without pressure. The types of lesions found in this study may be reflective of a large metropolitan population. It should also be noted that the dilated fundus examination was always performed after the nondilated examination, creating a risk that the subjects may have learned the art of being an examination subject. This risk was not considered a significant factor, however, because pediatric subjects generally have a short attention span, tire easily and become more uncooperative at the end of the examination.

The effectiveness of a dilated fundus examination should certainly influence a clinician's decision to routinely perform such examinations on pediatric patients. Yet, in an increasingly cost-conscious health care system, cost effectiveness and efficiency should also be considered. Clinicians should seek to combine thoroughness with efficiency whenever possible. An initial thorough dilated fundus examination should be followed by a dilated examination every few years (dependent on age) unless the initial examination was difficult to perform, ineffective, or revealed pathology that requires monitoring. In addition, the onset of new signs or symptoms, ocular trauma, or a change in health status would require additional examination. This protocol is in accordance with the recently published Optometric Clinical Practice Guideline for Pediatric Eye and Vision Examination. The guideline suggests all school-age children have comprehensive eye and vision examinations before the first grade and every 2 years thereafter. It also maintains that some children may require more frequent care depending on the nature of any diagnosed eye or vision disorder. These guidelines should be reviewed by all optometrists who provide care to a pediatric population.

References


Footnote

a. Pennsylvania College of Optometry, Philadelphia, PA.