

# The Pediatric Eye Exam in Primary Care



Welcome to “The Pediatric Eye Exam in Primary Care”, a podcast made for PedsCases.com at the University of Alberta. I am Jennifer Ling, a medical student at the University of British Columbia, and I am Harry Liu, a medical student at the University of Alberta. This podcast will provide an organized approach on performing the pediatric eye exam highlighting some common clinical findings. We will also provide indications for a referral to a pediatric ophthalmologist. We’d like to thank Dr. Ian MacDonald, an accomplished ophthalmologist and professor at the University of Alberta for developing this podcast with us.

Accurately performing a pediatric eye exam is vital to catching eye problems and preventing their progression during a child’s development. The Centre for Disease Control has found that over a given lifetime, visual disorders are the most disabling pediatric illnesses. For example, approximately 15-20% of children are at risk of developing amblyopia, also known as lazy eye, where one eye does not have normal visual acuity. Visual assessment by a healthcare provider is most vital at birth and during the first 6 months of life when the visual system is highly susceptible to interference. The main goal of vision screening is to identify children who have or are at risk for developing amblyopia or strabismus, which can lead to permanent visual impairment unless treated in early childhood. Other conditions that can be detected by vision screening include: cataracts, glaucoma, ptosis, refractive errors (e.g., myopia, hyperopia, and astigmatism), and other serious conditions, such as tumors and neurological diseases. If any of the conditions don’t sound familiar, don’t worry! We will cover them in a little bit.

## Objectives

- Discuss the importance of pediatric eye examination in primary care
- Develop an understanding of vision developmental milestones and age-appropriate eye examinations
- Demonstrate a focused eye history and accurately perform pertinent eye examinations
- List common signs and symptoms in pediatric eye conditions
- Discuss when to refer patients to a pediatric ophthalmologist and what pertinent information to include in referral letters

After listening to this podcast, the learner should be able to:

- Discuss the importance of pediatric eye examination in primary care
- Develop an understanding of vision developmental milestones and age-appropriate eye examinations
- Demonstrate a focused eye history and accurately perform various eye examinations
- List common signs and symptoms in pediatric eye conditions
- Discuss the indications for referral to a pediatric ophthalmologist and what to include in referral letters

## Case

It is your first day in a family clinic in Red Deer as a fourth year medical student. You are asked to see 9-month old Karl, who has come in for his well-child visit. Karl appears well today and his parents have no complaints on history. You are trying to recall which tests must be performed at this visit to ensure his eyes are developing normally ...

First, we'd like to present a case. It is your first day in a family clinic in Red Deer as a fourth-year medical student and 9-month old Karl, has come in for his well-child visit. Karl appears well today, and his parents have no complaints on history. You are trying to recall which tests must be performed at this visit to ensure his eyes are developing normally.

## Visual Development Milestones

Birth	visual acuity of 20/400, focus at 10 inches, responsive to stimuli
2 months	stable eye contact
3 months	focus at 8-15 inches, fixate/follow/look for objects
5 months	eyes straight, watch and copy hand movements
9 months	recognize faces, throw with good accuracy
2 years	decent hand-eye coordination
3 years	visual acuity of 20/40
4 years	visual acuity of 20/30
5 years	visual acuity of 20/20

First of all, let's quickly review some key vision developmental milestones. Here is a chart that summarizes the important milestones. Let's go over them. At birth, newborns have a visual acuity of 20/400. They can focus on objects that are 10 inches in front of their face, and blink in response to a bright light. They also respond to movement. From birth to 2 months, infants should be able to maintain stable eye contact when initiated by the caregiver. It is typical for their eyes to appear to cross or wander at times. However, it's concerning if their eyes consistently turn in or out. At 3 months, infants can see as far as 8-15 inches. The infant becomes aware of facial expression. You will find they are able to fixate on and follow objects, as well as look for objects. One clue is they will start watching their hands and bring their hands to midline and to their mouths. By 5 months, they will watch and copy the hand movements of other children and adults. Their eyes should be straight and do not appear to cross or drift by this point. When infants are 9 months old, they should be able to recognize family and caregiver faces, and throw things with better accuracy as now they have better depth perception. By 2 years, they should have decent hand-eye coordination. After that, they will continue improving their visual acuity. It is expected to be at least 20/40 at 3 years old, 20/30 by 4 years old, and 20/20 by 5 years old.

## Recommended Visual Tests by Age

Neonates	Glaucoma, infections, structural abnormalities <ul style="list-style-type: none"><li>● cataracts</li><li>● corneal opacity</li><li>● ptosis</li></ul>
1 month	Red reflex
2-18 months	Red reflex, corneal light reflexes, ocular motility, cover-uncover tests
2-5 years	Red reflex, corneal light reflexes, cover-uncover test, visual acuity

You probably have heard of Rourke Baby Record, which is an evidence-based health supervision guide for primary healthcare practitioners of children in the first five years of life. It contains guidelines and information for comprehensive well baby and child visits.

Here is a chart with relevant physical examination parameters for the eyes. For the newborn, you need to check for glaucoma, infections, and structural abnormalities including cataracts, corneal opacity, and ptosis. You need to pay special attention to preterm neonates who were given oxygen for an extended period of time and infants with multiple medical issues. For the well-baby check up at 1 month, check for the red reflex. For visits from 2 to 18 months of age, in addition to the red reflex, you need to check for the corneal light reflexes and ocular mobility, as well as to perform cover-uncover tests. This will be the case for our baby Karl. The tests for the visits from 2 to 5 years old are red reflex, corneal light reflex, cover-uncover test, and visual acuity. Great, now you know what eye tests to perform for different visits. Let's now talk about how to perform those physical examinations as well as taking a concise eye history when caregivers have eye concerns.

## Eye History and Physical Exam

Many eye and vision problems are difficult to detect on a short single visit so it is important to elicit a detailed history from the child's caregivers and carefully examine the child's eyes for any abnormalities, especially for preterm neonates or infants with other medical comorbidities.

## Taking a History

- Prenatal health and illnesses
- Medications
- Substance use during pregnancy
- Gestational Age at birth
- Child's eye contact
- Past ocular history
- Family history of eye diseases and blindness

First, you will begin with taking a history from the child's caregivers. If it's the first time you see the child, ask them about the child's overall health and maternal illnesses during the pregnancy, the route of delivery, and the baby's gestational age at delivery. Early gestational age before 28 weeks, low birth weight and oxygen supplementation after birth is associated with retinopathy of prematurity. These cases should be checked at birth and at 4-6 weeks of age, and referred to an ophthalmologist to be followed; many cases resolve spontaneously, but further treatment may be necessary. Also note any neonatal complications and/or interventions during history taking. Note any medication or substance use, especially smoking, by the parents. Multiple meta analyses have identified maternal smoking as a significant risk factor for childhood hyperopia, amblyopia, and strabismus. Make sure to ask about child's eye contact with their caregivers. If a child has poor eye contact after 2 months of age, this requires further assessment and referral to a pediatric ophthalmologist.

Second, you need to ask about the recent history of the child's eyes. Has there been chronic tearing or discharge? In the morning, is there crusting in and around the eyes? Any persistent redness or irritation should be noted. These suggest the possibility of blocked tear ducts, eye infections, allergies, or allergic conjunctivitis. Also inquire whether there is a past history of eye infections and allergies, in the child and in the family. This is important at every visit. In the newborn, blocked nasolacrimal ducts are common and may present as persistent tearing or discharge, as well as debris on the eyelashes. The vast majority of these cases are resolved in the first 6 months of development, but to promote the unblocking of the tear ducts,

you should be able to teach parents how to use a clean finger and massage downward from the inner corner of the eye to the nose. Parents should do this 2-3 times per day until the symptoms resolve.



## Risk Factors for Visual Problems

- Premature babies that have been given oxygen for significant periods of time
- History of congenital cataracts
- Maternal infections
- Down syndrome
- Cerebral palsy

Next, inquire about eye and vision problems in the family. Was anyone born with eye malformations such as strabismus or aniridia? Did anyone develop glaucoma or amblyopia? Are there any eye diseases that run in the family? Is anyone currently or previously blind? A family history of eye disorders will inform your physical exam to ensure you rule out similar abnormalities in your patient. Lastly, in conjunction with inspecting the infant, ask if the infant has demonstrated an eye turning inwards or outwards frequently or if one eye appears lazy. Also ask the caregiver if they have ever noted one eyelid more drooped compared to the other. Correlate those concerns to the child's vision developmental milestones because the management for the same concern will be very different depending on the child's age. Many factors besides a positive family history increase the risk for an eye or visual problem. These include:

- Premature babies that have been given oxygen for significant periods of time
- Congenital infections (such as Toxoplasmosis and CMV)
- History of congenital cataracts
- Down syndrome
- Cerebral palsy

## The Physical Exam

- Inspection
- Fix and Follow
- Red Reflex Exam
- Bruckner Test
- Corneal Light Reflex
- Cover/Uncover Test
- Visual Acuity Testing

Moving on to the physical exam, you need a child that is cooperative, alert and engaged. Sometimes, poor interest is indicative of poor vision by the child. It's important to watch the infant's visual interaction during the visit to see if there are any concerns or not. Usually, a child is most comfortable and agreeable to examination in the parent's lap, though children over the age of 4 are more cooperative. Talk to the child at an appropriate level and include play so that the child is more engaged and cooperative during the exam.

## Inspection



<http://www.carouselandrokinghorses.com/blog/wp-content/uploads/2011/06/childs-eyes-300x195.jpg>

First, you will inspect the eyes of the child. Notice any structural abnormalities, such as ptosis, corneal opacity or cataract, that may affect vision later. The eyelids should move together when the child blinks or shifts their focus. Check the periorbital skin for redness, inflammation, streaking or excess warmth that is indicative of infections such as periorbital cellulitis. When babies are first born, it's important to look for signs of congenital infections.

Then, you will observe the irises and pupils. There may be defects in the shape of the eyes, pupil irregularities, and differences in size between the two pupils. Normal pupils should be round, equal and reactive to light. Small variations  $<0.5\text{mm}$  in pupil size difference are tolerated, but if it's observed, it should be documented and checked at every visit. Symmetry should be observed in both light and dim light.

You need to inspect the sclera next. Normally, the sclera is clear, white, with a tinge of blue or gray. Some light-brown pigment spots can be seen near the iris at birth, especially in Asians, African-Americans, and dark-skinned races. An abnormal sclera may have lesions, discolorations, or one or more dark freckles; these findings require a referral to a specialist. A yellow-tinged sclera may indicate elevated bilirubin in the circulation or liver abnormalities; this finding requires blood work and further follow up until it is resolved. Also check if there is scleral injection, or, excess prominence of the

scleral blood vessels. No lacrimal duct discharge should be present and the eyes should move together during the inspection.

## Fix and Follow

Now you will ask the child to help you perform the next parts of the exam. First, let's examine whether the child can fix and follow objects. Newborns cannot fix and follow, but at 6 weeks, some babies will respond to the examiner's face. Most infants are able to fix and follow by 3 months old, and during this time, intermittent strabismus may be present but should disappear by 2-3 months postpartum. Each eye should be tested separately for sustained fixation and follow. Failure to fix and follow strongly indicates visual impairment, and if it is observed binocularly after 3 months, infants can have significant eye-brain abnormalities. This requires a referral to a pediatric ophthalmologist.

## Red Reflex Exam

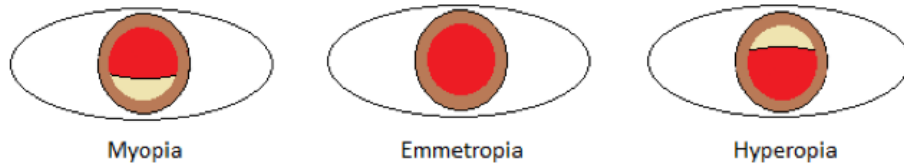


Leukocoria: <https://www.pedscases.com/approach-leukocoria>

[https://www.heine.com/en\\_US/specialties/ophthalmology/brueckner-test/](https://www.heine.com/en_US/specialties/ophthalmology/brueckner-test/)

To perform the **red reflex exam**, focus the ophthalmoscope light on each pupil from about 12 to 18 inches away. The light transmitted should reflect off the fundus and transmit back through the ophthalmoscope, giving the pupil a red appearance. This is what is often seen in pictures taken with flash photography. A normal finding would be equal, bright and symmetric. Abnormal findings include dark spots in the red reflex, reduced red reflex, white reflex, asymmetry of reflexes and an absent reflex. A white reflex is called leukocoria, which is discussed in one of our other PedsCases podcasts. Congenital cataracts result in increased corneal opacity so the red reflex cannot be observed; cataracts must be removed in the first 2-3 months of life as permanent loss of sight may occur. Any abnormal findings should be referred urgently. Moving further away, the Bruckner test can be performed at 1 meter away from the child. Both eyes should now show a red reflex.

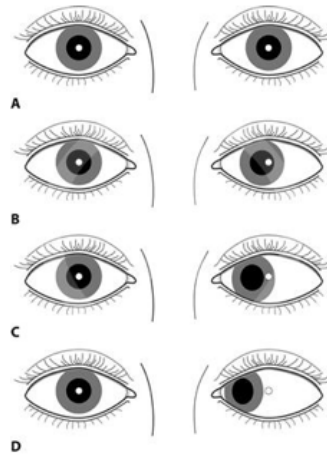
## Bruckner Test



<http://www.optometrystudents.com/direct-ophthalmoscope-the-ultimate-pediatric-screening-tool/>

If you see inferior crescents as shown in the diagram, it means the child is myopic. Superior crescents indicate hyperopia. Be aware that most children have some degree of hyperopia as their eyes are still immature. The Bruckner test assesses binocular vision and provides an indirect evaluation of refractive error. An abnormal finding would be if there is white in the pupil of one eye or whitening in both eyes; this is indicative of strabismus (misalignment of the eyes) or anisometropic amblyopia. In an abnormal finding, the optical power in each eye should be evaluated separately. Strabismus can be assessed by either the cover test or the Hirschberg test.

## Hirschberg Test



<https://www.aao.org/image/hirschberg-test-2>

In the **Hirschberg test**, the child stares at a penlight held 1 arm length away. The corneal light reflex should be centered on each pupil and be sharp. If there is strabismus, the light reflex will be off-center. If the child refuses to look at the light, the **cover/uncover test** may be performed. The child should focus on a target object, and the examiner will then cover each eye to look for a shift in alignment as the child looks at the object with each eye. Shifts in alignment suggest strabismus, but sometimes this is pseudostrabismus, which is common if the child has epicanthal folds or a wide nasal bridge. In pseudostrabismus, the corneal light reflex during the Hirschberg test should be symmetrical.



## Visual Acuity Testing



[http://www.365typo.com/wp-content/uploads/2015/07/frear\\_figure7-1024x1004.jpg](http://www.365typo.com/wp-content/uploads/2015/07/frear_figure7-1024x1004.jpg)

Last, let's briefly touch on **visual acuity testing**. This test indicates how well the child sees. In this test, the child must be cooperative and be able to read the vision chart. If the child cannot read, picture charts can be used. Optotype tests are the gold standard when testing visual acuity. Each eye needs to be tested separately.

## Common Findings during Pediatric Eye Exams

- Myopia and hyperopia
  - Headache, eye strain and blurry vision, squinting
  - Measure visual acuity with Snellen chart
  - Bruckner test
- Strabismus
  - Eyes not looking in the same direction at the same time or moving together
  - Squinting or closing one eye, tilting or turning head to look for object
  - Double vision, bumping into things
- Amblyopia
  - One eye or both may wander inwards or outwards with poor depth perception
- Leukocoria (see “[Approach to Leukocoria](#)”)

No matter if it is taking a history or performing the physical examination, it is always beneficial to keep the common causes or differentials in mind so you won't miss any important findings. Next, we will go over some important eye conditions in primary care settings, including myopia, hyperopia, strabismus, amblyopia, and leukocoria.

First are myopia and hyperopia. Myopia is nearsightedness, which means objects appear clear when close but blurry when far away. Light is focused in front of the retina. Hyperopia is farsightedness, which is completely the opposite. Distant objects are much more clear than near ones and light focuses behind retina. There is 1.5 increase in risk of developing hyperopia when women smoke during pregnancy. In terms of presentation, children may complain of headaches, eye strain, and blurry vision. The caregiver may notice squinting. The fast and easy way is to measure the visual acuity with the Snellen chart. When a child cannot read the eye chart, one quick method to determine if they are myopic or hyperopic is to perform the Bruckner (Brookner) test that was mentioned earlier.

Next, strabismus means misalignment of the eyes and if untreated, may result in permanent vision loss from impaired depth perception or amblyopia. The risk factors for strabismus include refractive errors, Down syndrome, retinopathy of prematurity, head injury, and maternal smoking during pregnancy. When strabismus is severe, it is easily noticeable as the children's eyes do not look in the same direction at the same time or move together. Alternatively, the child could be squinting or closing one eye at times, tilting or turning their head to look at an object, and complaining of double

vision. They could even bump into things.

Amblyopia is the inability to focus one eye. To simplify the pathophysiology, one eye has poor vision compared to the other, so the brain tries to use the good eye for adaptation and ignores images from the eye with worse vision. The visual development of the bad eye will be affected and permanent vision loss may occur. Minor refractive error and cataracts are risk factors for amblyopia. One eye or both may wander inwards or outward with poor depth perception.

Last but not least is leukocoria. Possible causes include congenital cataract, retinoblastoma, retinopathy of prematurity, and so on. Again, there is a podcast called "Approach to Leukocoria" by Dr. Novak for Pedscases. You can get more information from there.

## When to Refer to a Pediatric Ophthalmologist

- Premature babies
- Congenital disease affecting the eye
- Family history
  - Childhood cataract
  - Retinoblastoma
  - Glaucoma
- Corneal asymmetry
- Unilateral ptosis
- Pupillary asymmetry  $\geq 1$  mm

The following issues noted on history warrant ophthalmologic referral: retinopathy of prematurity, premature birth congenital infections such as CMV and Toxoplasmosis, a diagnosis of Down syndrome and a positive family history for childhood cataracts, retinoblastoma or glaucoma. Infants who do not track by 3 months of age should also be referred to a pediatric ophthalmologist. If the parents suspect the child has eye problems they should be referred to ophthalmology or optometry. Substance use or infections during pregnancy may result in congenital developmental defects that need to be investigated by pediatricians, neurologists and ophthalmologists.

Referral is warranted if inspection reveals: corneal asymmetry, unilateral ptosis, and pupillary asymmetry greater or equal to 1 mm. Corneal asymmetry is suggestive of glaucoma, and pupillary asymmetry is suggestive of neurological issues. During your physical exam, an abnormal red reflex, strabismus, nystagmus or amblyopia also needs to be referred. An abnormal red reflex should be referred as it may indicate cataract, glaucoma, retinoblastoma, strabismus or a significant refractive error difference between the two eyes. Finally, eye preference or a visual acuity difference of two lines or more between eyes should be referred to a pediatric ophthalmologist. In children 3-5 years old, visual acuity shouldn't be worse than 20/40, and in children over 6 years old, vision shouldn't be worse than 20/30. If visual acuity falls below that, the child should be examined by a pediatric ophthalmologist.

## Take Home Points

1. Rourke Baby Record for age-appropriate testing
2. The eye and surrounding area should be carefully inspected for any signs of infection, trauma or abnormal structure.
3. The red reflex should be normal in both eyes of the child, and any abnormalities should be referred.
4. Newborns and infants should be able to fix and follow with their gaze, and failure to do so after a few months of age requires an urgent referral to a pediatric ophthalmologist.
5. The alignment of the eyes should be checked with Bruckner test or the cover-uncover test, and strabismus should be referred to prevent long term consequences such as amblyopia.
6. Visual acuity testing is important to identify myopia or hyperopia early. It is important to involve both ophthalmology and optometry when the visual acuity is poor or when there is difference of 2 lines or more between eyes.

We hope you find our podcast helpful and you learn something new. There are some quick take home messages for you:

- 1) For well-baby/child check-up, refer to Rourke Baby Record for the indicated eye examination maneuvers.
- 2) The eye and surrounding area should be carefully inspected for any signs of infection, trauma or abnormal structure.
- 3) The red reflex should be normal in both eyes of the child, and any abnormalities should be referred.
- 4) Infants should be able to fix and follow with their gaze, and failure to do so after a few months of age requires an urgent referral to a pediatric ophthalmologist.
- 5) The alignment of the eyes should be checked with Bruckner (Brook-ner) test or the cover-uncover test, and strabismus should be referred to prevent long term consequences such as amblyopia.
- 6) Visual acuity testing is important to identify myopia or hyperopia early. It is important to involve either ophthalmologist or optometrist when the visual acuity is poor or when there is difference of 2 lines or more between eyes.

## Quiz Question 1

A mother brought in her 18-month-old son because her neighbor thinks her baby's eyes look "crooked". Which physical maneuver you can perform to measure ocular alignment in this child?

Corneal light reflex

We are not done yet. We have some quiz questions for you to show us how smart you are.

A mother brought in her 18-month-old son because her neighbor thinks her baby's eyes look "crooked". Which physical maneuver you can perform to measure ocular alignment in this child? The answer is corneal light reflex.

## Quiz Question 2

What are some risk factors for developing retinopathy of prematurity?

Gestational age less than 32 weeks

Birth weight under 1,500 g

Systemic hypoxemia

What are some risk factors for developing retinopathy of prematurity? The answer is gestational age less than 32 weeks, birth weight under 1.5 kg, and systemic hypoxemia.

## Quiz Question 3

What should you check for during eye exam in a newborn?

Glaucoma

Infections

Structural abnormalities (including cataracts, corneal opacity, and ptosis)

What should you check for during an eye exam in a newborn? The answer is glaucoma, infections, and structural abnormalities including cataracts, corneal opacity, and ptosis.



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This concludes our discussion. Thank you for listening to PedsCases Podcasts!