IMPORTANCE OF INFANT EYE CARE (OTHER)

Early eye examinations are important to maximize the likelihood of normal vision development in children. Normal eye and vision development is critical because vision is integrated with other sensory systems such as motor skills. The American Optometric Association recommends that infants should have their first eye examination as early as six months old, but unfortunately much of the public is not aware about this fact. The InfantSEE® program was developed by Optometry Cares – The AOA Foundation and Johnson & Johnson’s The Vision Care Institute LLC in 2005 as a public health initiative to promote the importance of early eye care by providing comprehensive eye examinations to infants between 6 and 12 months of age at no cost.

Eye examinations are recommended at 6 months of age because many ocular findings manifest and mature by this age. Accommodation develops into adult levels around 3-4 months. The binocular visual field of 6-7 months old infants was found to be 93% that of adults. Oculomotor function, specifically pursuits, is present at 6-8 weeks, but has significant improvements by 4 months of age. Gross convergence also develops around 3-4 months of age.

CASE HISTORY

Case history should begin with questions about the pregnancy. A positive history of premature birth (< 31 weeks), low birth weight (< 1250 grams), or prolonged exposure to postnatal oxygen puts the infant at risk for a high refractive error, strabismus, and ocular pathology (such as retinal detachment, macular dragging, glaucoma and cataracts). Questions about the infants’ visual status are also important. For example, does the infant make appropriate eye contact? Also ask the parents if their child appears to have an eye turn or if there is a history of redness, tearing, discharge, or eye rubbing. It is important to rule out medication allergies if ocular medications are being prescribed. Since many ocular conditions are hereditary in nature, a thorough assessment of the infant’s family medical and ocular history needs to be obtained.

VISUAL ACUITY

Infants should be examined quickly because they can easily lose their attention. Since most testing is done objectively, infant eye examinations are typically completed in a relatively short amount of time. The parent can hold the infant in their lap during the examination. However, if the infant is active and moves around, it may be easier to examine them while they are lying in the stroller, as seen in picture 1. Visual acuity can be assessed with forced choice preferential looking acuity cards. In case the infant becomes fussy with occlusion, it is a good idea to test binocular acuity first. If there is a suspect eye (for example, the parent reports the child’s left eye turns in), that eye should be tested first when performing monocular acuities. An advantage with the forced choice preferential looking cards is that examiner bias can be eliminated by ensuring the examiner does not know which side the gratings are on (see picture 2). If the findings are unreliable or the infant resists occlusion, a gross assessment with the 10 vertical prism test should be done to determine if there is a fixation preference. For this test, a 10 prism diopter base up (or base down) loose prism is placed over one eye, thus vertically dissociating both eyes. If there is no fixation preference, the infant should spontaneously fixate between the two vertical images. If there is a lack of spontaneous fixation, there may be a fixation preference. Objective findings such as retinoscopy should be taken into account to determine if the refractive error supports the presence of a fixation preference. It is also worth noting if the infant has equal resistance to occlusion or gets fussy if one particular eye is covered.

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The infant is calm and comfortable in her stroller, which makes it much easier to perform the examination.

The examiner is not biased to the infant’s gaze because she does not know where the gratings are located.

**ENTRANCE TESTING**

Extraocular muscle testing can rule out cranial palsies and muscle restriction, although these findings are rare in the infant population. If the infant has a hard time following a target, the “dolls head reflex” technique can be performed instead. For this test, the infant’s head should be rotated side to side and up and down to see if their eyes move in the opposite direction of head movement (see picture 3). Near point of convergence testing should be done to determine if gross convergence is intact. Pupil testing can reveal neuro-ophthalmic conditions, so this should be included in the comprehensive eye examination as well. Visual fields are grossly evaluated by presenting a target from non-seeing to seeing areas. It is beneficial to use entertaining targets when performing these tests to maintain the infant’s interest during testing. These targets should be colorful, light up, and/or be noisy. These entrance tests are all important, but the three main areas to evaluate during an infant eye examination are refractive error, ocular alignment, and ocular health to check for amblyopia (refractive, strabismic, and deprivalional), strabismus, and ocular pathology.
The “doll’s head reflex” technique is being done by having the infant fixate on the examiner’s face and rotating the infant’s head side to side to check the integrity of her extraocular muscles.

**REFRACTIVE ERROR**

Amblyopia is present in 3% of the population and is easily treatable if detected early. A thorough evaluation of refractive error is critical to rule out the possibility of refractive amblyopia.

While it is useful to perform dry retinoscopy, there can be fluctuation in the findings due to changes in accommodation. Using a noisy spinning toy in the background or playing a movie with a familiar song may help maintain the infant’s fixation during retinoscopy. An alternative to dry retinoscopy is the Mohindra technique, which is performed in a dark room with a 50 cm working distance. The test is performed monocularly and the infant is to fixate on the retinoscope light. Instead of subtracting the examiner’s working distance, 1.25 DS is subtracted from the sphere power. The advantage of the Mohindra technique over dry retinoscopy is that accommodation is believed to be better controlled.

However, the most accurate way to assess refractive error is with a cycloplegic evaluation in order to best control accommodation. In infants younger than 1 year of age, two drops of 0.5% cyclopentolate should be used. Punctal occlusion should be performed after drop instillation to minimize systemic absorption. After drop instillation, it is perfectly fine (if not preferred!) to have the infant fall asleep as it much easier to examine a sleeping baby during the dilated fundus and cycloplegic examination.

Based on the AOA Clinical Practice Guidelines, potentially amblyogenic refractive errors are as follows:

<table>
<thead>
<tr>
<th>ISOAMETROPIA</th>
<th>ANISOMETROPIA</th>
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</thead>
<tbody>
<tr>
<td><strong>Myopia</strong></td>
<td><strong>Myopia</strong></td>
</tr>
<tr>
<td>-8.00 DS</td>
<td>3.00 DS</td>
</tr>
<tr>
<td><strong>Hyperopia</strong></td>
<td><strong>Hyperopia</strong></td>
</tr>
<tr>
<td>+5.00 DS</td>
<td>1.00 DS</td>
</tr>
<tr>
<td><strong>Astigmatism</strong></td>
<td><strong>Astigmatism</strong></td>
</tr>
<tr>
<td>-2.50 DC</td>
<td>1.50 DC</td>
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If the refractive error is found to be of borderline concern, a good rule of thumb to follow is the “3 by 3 rule” to monitor for changes before initiating treatment. We suggest having the infant return for three follow up cycloplegic evaluations spaced three months apart to monitor changes in the refractive error. While the above table serves as guidelines for amblyogenic refractive errors, it is very important to understand that certain refractive errors should be corrected for even though they may not be considered potentially amblyogenic. For example, infants with hyperopia greater than +3.50 DS are at risk for development of accommodative esotropia and infants with uncorrected moderate myopia may have a difficult time interacting visually with their
environment, which may lead to a delay in their developmental milestones. Thus, it may be beneficial to correct the refractive errors in these cases even though they are not considered amblyogenic. In addition, if a borderline refractive error remains stable, the child’s vision is decreased due to the uncorrected refractive error, or the parents have visual concerns supported by exam findings, prescribing corrective lenses should be considered. The general rule for prescribing for infants is to keep the full myopic and astigmatic correction found on the cycloplegic evaluation, however, the astigmatic component may be reduced depending on changes over time as a result of emmetropization. The spherical component for hyperopia is generally decreased equally in both eyes unless the infant has esotropia. In cases of esotropia, full hyperopic refractive error should be prescribed. Note that even if visual acuity is not affected, an uncorrected hyperopic refractive error, can affect early literacy development.

**OCULAR ALIGNMENT**

Strabismus is present in 2.1-3.6% of preschool children. Early diagnosis and treatment of strabismus is critical to promote normal binocular development.

Ocular alignment should be assessed with the Hirschberg/Kappa test. For the Hirschberg test, a transilluminator is shined at the bridge of the infant’s nose and the corneal light reflex is evaluated to determine if it is centered or displaced nasally or temporally. For the Kappa test, each eye is covered to assess if the reflex moves. Each millimeter displacement between the Hirschberg and Kappa findings is about 22 prism diopters. Using the Krimsky method, the amount of deviation can be quantified by placing neutralizing prism in front of the deviating eye until the corneal light reflexes are symmetrical between both eyes. If the infant has poor fixation, try rapidly tapping the light source with an index finger to make the light flicker and create a more engaging target.

The three main types of esotropia seen in infants is congenital, accommodative and pseudoesotropia. It is important to rule out congenital esotropia, which is typically a large angle constant inward eye turn that typically manifests within the first six months of life. The timing of surgery for congenital esotropia has been debated because the condition may spontaneously resolve without surgery. However, spontaneous resolution is less likely if the esotropia is constant and had a large magnitude (greater or equal to 40 prism diopters). One study reported that strabismus surgery should be recommended earlier (at or before 11 months old) to promote better sensory outcomes by restoring binocular fusion and improving cortical development. Although there are some concerns about potential side effects associated with early surgical intervention, the same study supports that early surgery does not increase risk of needing reoperation.

Accommodative esotropia can onset as early as 4-6 months of age. If accommodative esotropia is suspected, full hyperopic correction based on a cycloplegic evaluation should be prescribed. Pseudoesotropia may be present if an infant appears to have an esotropia due to a wide nose bridge and prominent epicanthal folds. However, infants diagnosed with pseudoestropia have a higher chance of developing strabismus or amblyopia, so these infants with this condition should be closely monitored.

Intermittent exotropia (IXT) is more common than infantile exotropia, with one study reporting the incidence rate of IXT to be 32.1 out of 100,000 children. Infantile exotropia develops between two to four months of age, but it is such a rare condition that there are few studies reporting its true incidence. One study reported only 2 in 3000 infants (6 per 100,000) develop infantile exotropia. Although it is a rare condition, infantile exotropia is more likely to coexist with ocular and systemic disease compared to infantile esotropia. Some ocular conditions that are associated with infantile exotropia include optic nerve hypoplasia and congenital cataracts. Since neurologic diseases such as Chiari malformation and cerebral palsy are common systemic diseases associated with infantile exotropia as well as infantile esotropia, infants with these conditions should be referred out for further testing and possible neuroimaging.

Intermittent exotropia, on the other hand, usually does not require immediate treatment. A study conducted by the Pediatric Eye Disease Investigator Group (PEDIG) found no evidence to recommend part-timing patching for the treatment of IXT in children between 12 to 35 months of age. The study also found deterioration of IXT was uncommon in this age group. Deterioration was defined as constant exotropia measuring at least 10 prism diopters at distance and near or treatment that was initiated even though the deviation was not constant. Although deterioration of IXT in infants in uncommon, these children should still be routinely monitored for changes in their condition over time.
OCULAR HEALTH
Anterior segment should be grossly evaluated with a transilluminator and a 20 D condensing lens (see picture 4). Nasolacrimal duct obstruction is one of the most common anterior segment conditions found in infants. It can cause excessive tearing as well as mucous discharge. If these symptoms are reported, the dye disappearance test should be performed by placing fluorescein in both eyes and assessing how long the dye remains. If the dye remains in the eye for at least ten minutes after instillation, nasolacrimal duct obstruction should be suspected. Treatment for this condition involves digital pressure to the lacrimal duct at least four times a day. Topical antibiotic ointment may be prescribed if a concurrent bacterial infection is present. Fortunately approximately 90% of cases will spontaneously resolve by 1 year of age. However, if the condition persists past this age, a referral to an ophthalmologist for nasolacrimal duct probing should be considered.

PICTURE 4: A transilluminator and 20 D condensing lens are used together to examine the infant’s anterior segment.

When performing the dilated fundus examination, use noisy toys that light up to maintain the infant’s fixation in different gazes. It is also helpful to have the infant drink from their bottle during the posterior segment assessment so that they are distracted from the lights. As mentioned earlier, it is much easier and ideal to perform the dilated fundus examination on a sleeping infant. In those cases, the examiner will need to move themselves and also the infant’s head to obtain views in the different gazes.

Dilated fundus examinations to assess the posterior segment are indicated to rule out ocular pathology, such as retinoblastoma. Retinoblastoma is a rare but life threatening condition, thus early diagnosis is critical to save not just the child’s vision, but their life as well. Retinoblastoma should be suspected if single or multiple flat or raised lesions, are seen on a dilated fundus examination. The lesions are usually white, but can also be pink, yellow or whitish-gray. In 60% of retinoblastoma cases, instead of a normal red pupillary reflex, the infant will have a white pupillary reflex. Strabismus may also occur in 20% of retinoblastoma cases. If there is suspicion for retinoblastoma, immediate referral to a pediatric retinal specialist is imperative to save the infant’s life.

Retinopathy of prematurity can occur in infants who were born premature, where abnormal blood vessels grow in the retina and potentially cause retinal detachments in the future. Congenital cataracts should also be ruled out, because they can result in deprivational amblyopia if the cataract is located in the infant’s line of sight. Congenital glaucoma should be suspected if symptoms of tearing and photophobia are present as well as an enlargement of the globe (buphthalmos). During the examination, corneal clouding, megalocornea and an increased cup-to-disc ratio may be seen.

CONCLUSION
Providing infant eye examinations allow optometrists an opportunity to educate the community about the role of the optometrist in early eye and vision care. Most parents are not aware that eye examinations are recommended as early as six months of age. At the conclusion of the examination, it is valuable to explain to the parents exactly what conditions were ruled out instead of just stating that everything was found to be normal. In addition, encourage them to help spread the word about the importance of early eye examinations to their friends and family.
To summarize, the main conditions to rule out during an infant eye examination are significant refractive error, amblyopia, strabismus, and ocular pathology. If there are no abnormalities at the infant’s first examination, AOA guidelines recommend that the child should be next examined at three years of age.\(^\text{18}\) Examining infants is a rewarding experience and allows optometrists the opportunity to treat any eye and vision conditions early to promote the infant’s normal overall development. The importance of infant eye care should be promoted by pediatricians, ophthalmologists and optometrists. If a comprehensive eye examination cannot be provided by the health care practitioner, the infant should be referred to an eye care provider who specializes in pediatrics.

References:

1. The InfantSEE program was developed to provide comprehensive eye examinations to infants.
   d. 3-12 months of age
   e. 6-12 months of age
   f. 6 months to 2 years of age
   g. 1-2 years of age

2. Infants are at risk for high refractive error, strabismus, and ocular pathology if they are born at:
   a. 28 weeks
   b. 38 weeks
   c. 42 weeks

3. True or False: Amblyopia is present in 5% of the population.
   a. True
   b. False

4. Infantile exotropia is more likely to coexist with ocular and systemic disease compared to infantile esotropia.
   a. True
   b. False

5. For the Mohindra technique, what should be subtracted from the sphere power to determine the net dry retinoscopy findings?
   a. 2.00 DS
   b. your working distance
   c. 1.25 DS
   d. 1.00 DS

6. In infants younger than 1 year of age, 2 drops of 1% cyclopentolate should be used.
   a. True
   b. False

7. Which of the following can be a life threatening condition?
   a. Pseudoesotropia
   b. Retinoblastoma
   c. Intermittent Exotropia
   d. Nasolacrimal Duct Obstruction

8. For the Hirschberg/Kappa test, how many prism diopters are equal to each millimeter displacement between the Hirschberg and Kappa findings?
   a. 11 prism diopters
   b. 22 prism diopters
   c. 5 prism diopters
   d. None of the above

9. Part-time patching should be prescribed for infants who present with an intermittent exotropia.
   a. True
   b. False

10. 90% nasolacrimal duct obstruction resolve by:
    a. 6 months of age
    b. 12 months of age
    c. They do not resolve, surgery is indicated for all nasolacrimal duct obstructions