OPTOMETRIC EXAMINATION & MANAGEMENT OF THE INFANT

THE BASICS

IRA KRUMHOLTZ, O.D.

Abstract

A comprehensive optometric evaluation of the infant should include all of the standard tests performed when examining the adult. However, these procedures must be modified for the infant. The successful examination and management of the infant requires knowledge and understanding of the infant's visual system. Proper diagnosis and management is crucial especially in the early years when growth is so rapid.

Key Words

infant, ocular and visual examination, Teller acuity cards, strabismus, amblyopia

As optometrists become increasingly involved in primary eye and vision care, i.e., "gatekeeping," more infants will find themselves in optometrists' offices. Because of the major role that vision plays in general development, coupled with the fact that infancy is the height of the sensitive period[1] during which early treatment significantly increases the chances of success,[2] full scope and enlightened optometric care is often crucial.

The infant's initial optometric examination should be administered within the first year of life but after the age of 3 months. Prior to 3 months, the infant's visual system is not stable enough to derive an accurate assessment. For the purpose of this paper, infancy is defined as the first 18 months of life.

Case History

As with the adult, the reason(s) for the examination must be determined. These may include a general preventative evaluation, apparently decreased vision, clumsiness, rubbing and redness of the eyes, strabismus, and/or a family history of visual problems. General health, including pre- and post-partum histories and medications, are important information as are parents' observations. The optometrist sees the infant for a relatively short time, while the parent is a constant observer. Previous assessments and treatments should also be determined.

Taking a complete case history before beginning the examination may consume valuable time and it is important to garner the information as quickly as possible. The need for both accuracy and efficiency apply to all procedures. Therefore, it is helpful to send the parents a questionnaire (see Appendix A), which is to be completed before the visit so most of the required information is available before the examination.

The questionnaire also gives the parents the opportunity to consult other medical records if necessary. Some have criticized the use of the questionnaire on the grounds that the same information will be discussed anyway and it can eliminate the important "give and take" between doctor and parent.[3] On balance, however the questionnaire is valuable when used a basis for further discussion.

Visual Acuity

When examining infants, one needs to be flexible with the standard regimen of the optometric examination. An example of this is visual acuity, which may not be the first procedure performed.

A gross assessment of vision is obtained when the infant fixates on an object, usually a light or a metallic item like a gold watch. However, this only indicates that the infant is not blind. Another gross test of acuity is the graduated size ball test. It uses spheres that are rolled in front of the infant with variations in the size of the ball, the speed at which it is rolled, and the distance rolled.[3]

A more quantitative measurement of acuity utilizes the optokinetic nystagmus reflex (OKN). OKN (see Figure 1) has been demonstrated in infants 75 minutes after birth.[4] It is a physiological ocular nystagmus induced by the attempt to fixate objects rapidly transversing the visual field.[5] The drum is initially rotated and placed about 15 inches from the infant. Once the response is elicited, the parent or assistant continues to rotate the drum

Figure 1. OKN Revolving Drum.

while gradually increasing the distance from the infant. The practitioner observes the nystagmus to determine the distance at which it is no longer detectable. The size of the stripe width on the drum, combined with the furthest distance the response is present, is used to calculate the visual angle. This can then be converted into standard Snellen acuity. Questions have been raised about the validity and accuracy of this test, especially since OKN has been elicited in cortically blind individuals.[6]

Until electrophysiological testing became available, specifically the Visual Evoked Potential (VEP), it was believed that an acuity of 20/20 was not attainable until the age of 5 or 6 years. The VEP has shown that at six months after birth, the "neurological" wiring needed for 20/20 acuity is present.[7] VEPs are clinically used occasionally to measure potential acuity in infants. The infant is placed in front of a display screen. A pattern of alternating checks is flashed and the response is transmitted via electrodes placed on the infant's head. Two major disadvantages with the VEP are its cost and interpretation of complex data.[8]

The most popular method to accurately measure acuities in infants is the Teller acuity card method.[9] Each card consists of a spatial frequency grating on the left or right side, with a blank grayish area on the other lateral side (see Figure 2). Each card in the series has a higher spatial frequency (and higher visual acuity) than the previous one. Infants prefer to look at a high contrast form rather than a dull homogeneous gray field.[10] The card is presented to the infant while fixation is monitored. The examiner should initially be unaware of which side has the grating so as not to bias the findings. If the infant is sitting on his or her parent's lap, steps should be taken so that Mom or Dad does not help the infant make the correct decision. All other visual cues in the environment should be eliminated. This can be accomplished by building a stage with a window the size of the acuity card. When the infant's attention is captured, slip the card into the slot. A few trials should be made at each acuity level to reduce the possibility of chance. The doctor keeps presenting cards of finer acuity (higher spatial frequency) until most of the responses are incorrect. Spatial frequency is then converted into Snellen acuity.

Figure 2. Teller Acuity Card.

The Teller card procedure is time-consuming; therefore, it is difficult to take acuities for the right, left and both eyes at a single visit. Consequently, when assessing acuities, first test the eye in which you are most interested. If no apparent problems are present, you or the parent may still want to determine the acuity to compare it to the expected for that age. In this case, only a binocular acuity is needed. If, on the other hand, the chief complaint is a constant, unilateral turn that is confirmed with a cover test, then obtain the acuity of the deviating eye, as the chances of this eye developing amblyopia are great. The Teller card technique works best between the ages of 3 and 9 months, with peak responses occurring around 6 months.[11]

Between the ages of 1 and 2 years, acuity is very difficult to measure. Infants approaching the toddler stage are usually too motoric to give reliable responses on the Teller cards[8] and they still have not developed adequate language to use the Broken Wheel, Tumbling E or Lighthouse Picture Chart.

Cover Test

The cover test is a relatively simple yet important test because the development of amblyopia can be predicted based on ocular alignment. Therefore, depending on the chief complaint, this might be the first test administered. If the child demonstrates a turn that is constant, some degree of amblyopia will surely exist. Conversely, if the child appears to be intermittent, the acuity in the two eyes are more likely to be close to equal. A penlight or a transilluminator should be used for the Hirschberg method. The child, sitting on his or her parent's lap fixates an object, while the doctor views the corneal light reflex. The magnitude of the deviation can then be estimated. Each millimeter of decentration on the strabismic eye corresponds to between 14-22 prism diopters.[12] Occluders should not be used for the cover test. Rather, a hand should be rested gently on the infant's head and a thumb used to occlude the eye.

Ocular Motilities

Using a penlight, motilities can be tested. In a darkened room, most infants will stare at the light. The light is then moved into the nine cardinal positions of gaze. Gently hold the infant's head to prevent any head movements. If the infant does not respond, the "doll's head reflex" can be used: In this technique, the doctor moves the baby's head to the cardinal positions to determine any gaze restrictions.

Refraction

Some practitioners will perform keratoscopy (see Figure 3) to obtain a rough estimate of corneal toricity. Circular rings signal a spherical cornea, while oval or distorted rings indicate corneal astigmatism. However, most practitioners rely on retinoscopy to determine the presence of astigmatism.

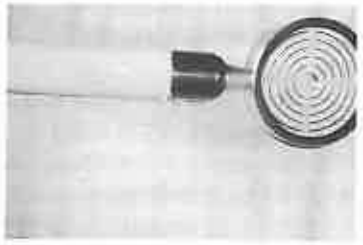

Figure 3. Keratoscope

For distant objective refractive determination, a retinoscope, lens racks and a good fixation target are needed. If the infant shies away from the lens rack, loose lenses should be used. Mohindra retinoscopy utilizes the light of the retinoscope as the fixation target. Mohindra retinoscopy is performed monocularly at a 50 centimeter working distance in a darkened room.[13] From the gross finding, -1.25 D is algebraically added. For example, if the gross sphere is -2.00 D, the final correction is -3.25 and if the gross finding is +2.00, the net result is +0.75.

One of the criticisms of this procedure is that the -1.25 "fudge" factor was determined on the basis of empirical evidence.[3]

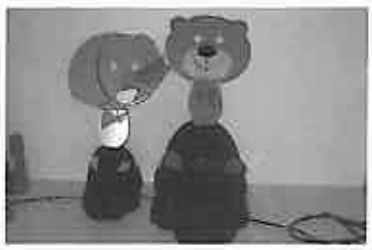

Figure 4. Masks for near retinoscopy.

The fact that this seemingly "arbitrary" amount has been accepted is probably because of the dark focus state of accommodation which is approximately 1.25 diopters.

Some practitioners choose to perform nearpoint retinoscopy to determine the infant's nearpoint refractive status because in early infancy this is the preferred distance. A mask with cutouts for the eyes is used (see Figure 4). This type of stimulus is attractive to the infant and can therefore hold his or her attention long enough so that this procedure can be completed.

Ocular Health Testing

Intraocular pressures (IOPs) can be measured. Primary methods of taking IOPs in infants include: a hand-held Goldmann, a non-contact tonometer, such as the Tonoped, or if need be, Schiotz with sedation.[14]

A slit lamp examination may be performed either with a hand-held slit lamp or with a monocular indirect ophthalmoscope. At this point, pupil reactivity can also be checked.

A dilated fundus examination can be combined with a cycloplegic examination. The appropriate drops and dosage for the dilation are 1/2-1% Cyclopentolate and 2.5% Phenylephrine separated by five-minute installations.[15] If that is insufficient, 1/2-1% Tropicamide may also be used.

The side effects of the diagnostic drugs must not be ignored. The parent must be apprised of possible side effects, which may include sleepiness, seizures, apnea and respiratory distress, and occasionally may cause paralytic ileus or enterocolitis.[15]

For the purpose of evaluating the fundus, a monocular indirect, a direct ophthalmoscope or a binocular indirect can all be considered. An effective way to hold the infant for both binocular indirect ophthalmoscopy and drop installation is to use a "reverse cradle" position. The parents hold the infant's arms and legs and the infant's head rests on the examiner's legs, freeing the examiner's hands to hold the lids open. When it is difficult to keep the eye immobile for pressures or the dilation examination, a lid clamp (speculum) may be used.[16]

Management Considerations

It is crucial to bear in mind that the infant visual system is not merely a smaller version of the adult's. It is different and must be viewed in terms of a developing system rather than the adult finished product.

One variation in the infant is that acuity does not start at 20/20 but increases by the month. With regard to refraction, most studies concur that under cycloplegia, the infant shows about three diopters of hyperopia.[17] However, there is a wider range of opinions regarding the non-cycloplegic or "dry" findings. This range extends from mild hyperopia to some degree of myopia. Existence of reliable norms under cycloplegia is an additional reason for performing this type of retinoscopy.

Against-the-rule astigmatism is also generally present. Up to two diopters during infancy can be considered normal.[18] Therefore, it is important to monitor the infant to make certain that the astigmatism gradually decreases.

Because of established norms in these areas, it is now possible to consider those findings outside the normal limits. As mentioned earlier, the infant usually has a refractive condition that is hyperopic and may also have an associated astigmatic component. Some clinicians believe that these "errors" will correct themselves through the process of emetropization (i.e., the natural course of the eye becoming emmetropic) and that prescribing for moderate amounts of refractive error may actually prevent this process from taking place.

Specifically, an infant with mild amounts of myopia early in life is not at risk because the infant's "clear" zone is near space and it is near space where the infant spends his or her time. Intervention, however, would be necessary in the higher myope. Myopia exceeding five or six diopters may induce a refractive amblyopia and, therefore, needs full or partial correction.

The treatment strategy for the hyperopic eye consists of monitoring the infant to see that the small amount of hyperopia evolves into emmetropia. If, however, the initial hyperopic "dry" finding is greater than a few diopters, optical intervention is necessary.

Astigmatism of the infant should gradually lessen with the process of emetropization.[19] The problem occurs when the astigmatism does not diminish. Two diopters of uncorrected astigmatism does not cause enough "blur" to trigger amblyopia until the age of 1 1/2 - 2,[20] so studies support deferring treatment with the mild astigmat. Again, a large astigmatic error requires earlier correction.

The final refractive condition to be addressed is anisometropia. Anisometropia, and especially, antimetropias, are clinically considered to be a trigger for amblyopia. Anisometropia of even two to three diopters can cause amblyopia. In these cases, one should consider early optical intervention.

In addition to a general preventative evaluation and apparently decreased vision, strabismus is a leading reason for parents to seek an optometric examination. Most infants are born with a strabismus[21] but if it is present after 3 months, the infant will not "grow out of it."

Therapy for a constant strabismus will greatly differ from that of an intermittent turn. If there is an alternation and both eyes are stimulated about equally, care consists of monitoring both the acuity a the turn. There is the possibility that an intermittent or alternating turn will become constant. If the turn is constant, therapy, for which several different options are available, should be more aggressive. The first option is direct occlusion, which forces the turned eye to pick up fixation, in turn stimulating the eye and preventing amblyopia. As with most therapies, there is a range of opinions regarding patching regimens. There are those who believe that constant, full-time patching is necessary, some who believe in parttime direct occlusion, and still others prefer a form of alternate patching to avoid the possibility of inducing occlusion amblyopia.[22]

Another treatment option is the use of gingham patterns (see Figure 5). These are similar alternating fields so that even with the eye turned, identical information is

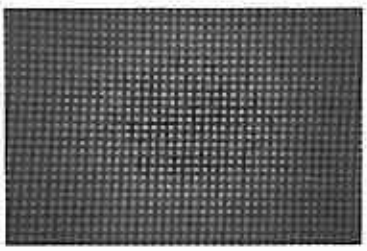

Figure 5. Gingham patterns.

being presented to both fovea.[22] These cloth gingham patterns can be draped over the sides of the crib. The goal is to have the cortical binocular cells activated so that a future therapy is possible.

Surgery is among the options that may be considered. Alignment in this period will increase the chances for the development of binocular vision.[1]

Prisms and lenses can also be used. Prisms make the infant a sensory orthophore by exactly neutralizing the angle of squint, are used to stimulate cortical binocular cells. One must carefully follow these infants to detect anomalous retinal correspondence. This would cause the infant to adapt or "eat up" the prism, thereby increasing the angle of squint. Lenses are most commonly used in the case of an accommodative esotropia. Accommodative esotropias are usually not seen until the age of 2 - 2 1/2. However, cases have been reported as early as 6 months as accommodation is adult-like at this age.[23] A cycloplegic refraction should be performed on all infant esotropes in order to determine the presence of an accommodative component. The recommended method is to instill 1/2-1% atropine ointment for three consecutive nights and the morning of the examination.[2]

Conclusion

Examining infants is a challenging yet rewarding experience. A complete basic examination sequence and an outline of treatment options for infantile visual problems have been presented. One of the leading causes of monocular vision loss under the age of 35 is amblyopia, an easily diagnosable and treatable entity. A cover test and retinoscopy is all that is required to be performed on the infant, eliminating the two major causes of amblyopia: strabismus and refractive error. The basic optometric examination of the infant and an appropriate therapy program can yield tremendous rewards for the practitioner and immeasurable benefit to the infant as he or she becomes more visually active.

APPENDIX A
INFANT'S VISION QUESTION FORM

NAME _____

ADDRESS _____

TELEPHONE # _____

INFANT'S BIRTHDAY/AGE _____

1. REASON FOR VISIT
   _____ EYE TURNS IN _____ EYE TURNS OUT
   _____ SQUINTING _____ DOESN'T SEE THINGS
   _____ RUBS EYES A LOT _____ GENERAL CHECK-UP
   _____ OTHER (PLEASE SPECIFY):
2. MOTHER'S AGE WHEN CHILD WAS BORN _____
3. LENGTH OF PREGNANCY _____
4. LABOR LASTED FOR _____ HOURS
5. LABOR _____ WAS _____ WAS NOT INDUCED
6. DELIVERY WAS _____ NATURAL _____ CAESARIAN
   _____ ANESTHETIC _____ FORCEPS
7. ANY COMPLICATIONS WITH THE DELIVERY _____
8. CHILD'S BIRTH WEIGHT _____
9. FAMILY HISTORY (CHECK ALL THAT APPLY)

	Near-Sighted	Far-Sighted	Astigmatism	Lazy Eye	Turned Eye
MOTHER					
FATHER					
BROTHER					
SISTER					

10. CHILD'S PEDIATRICIAN _____

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Corresponding author:
Ira Krumholtz, O.D.
SUNY State College of Optometry
100 E. 24th Street
New York, NY 10010

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