Challenging work for the optometrist

Examining special populations

Part 3: Examination techniques

Marc B. Taub OD, FAAO, Stephanie Rowe OD and Mary Bartuccio OD, FAAO

The next two articles in this series will discuss the modifications of a regular primary care eye examination to accommodate special needs patients. This article will discuss the tools which can be used to evaluate visual function, and how to perform these tests. It will also focus on history and preliminary testing.

History

Preparation for examining a patient with special needs should ideally begin before the patient enters the practice. Intake forms and questionnaires on the patient's medical and ocular history can be sent out beforehand[1]. This information will provide insight about the patient's needs and their level of functioning[2]. Acquiring any existing information from previous eyecare specialists on refractive errors, eye surgeries and any anterior or posterior segment conditions should also be obtained prior to the examination[1,2]. Discussion of any occupational and physical therapy services used can also provide background about the patient's developmental level. Educators and rehabilitation specialists can provide valuable insight regarding, for example, an unusual head tilt or posture, or illumination and glare problems[1].

When assessing medical history, note any ocular or systemic medications and the length of time they were taken. Being familiar with commonly used medications and their side effects is important, due to the secondary visual side effects which can occur[1,2]. Anti-seizure medications, such as Divalproex Sodium (Depakote®), have been reported to cause visual hallucinations, nystagmus, and subconjunctival or retinal haemorrhages[3]. Some CNS (central nervous system) agents used to treat anxiety, such as Alprazolam (Xanax®), have been reported to cause blurred vision and colour vision defects[2,3]. Anti-psychotic agents, when taken over a long period of time, can produce significant ocular side effects including stellate cataracts, paralysis of extraocular muscles, and pigmentary deposits on the cornea[3].

»About the authors

Dr Marc B. Taub and Dr Mary Bartuccio are Assistant Professors in the Pediatrics and Binocular Vision Service at Nova Southeastern University (NSU) in Ft. Lauderdale, Florida. Dr Stephanie Rowe is currently completing a residency in Primary Care with an emphasis in Pediatrics at NSU

Colour vision testing

Colour vision testing can offer important diagnostic information about a child's ocular health and their capabilities. For example, a colour deficiency may be the culprit if a parent is not having success teaching their child the names of colours. Parents will certainly find this information very valuable[4].

Color Vision Testing Made Easy (CVTME)

Color Vision Testing Made Easy (CVTME) is a way to test colour vision in patients who do not know their numbers. It consists of nine to 14 pseudoisochromatic plates with symbols such as a star, circle and square. The patient is asked to name the shape. If they cannot communicate verbally, the test can be performed by asking the patient to trace the shapes with a cotton tipped applicator or a small paint brush[2].

Ishihara Plate Test

The patient is asked to identify numbers or shapes which are seen on pseudoisochromatic colour plates. Like the CVTME, this test can also be performed using a cotton tipped applicator or a paintbrush if the patient is non verbal[2].

Wool/Yarn Test

This test is performed by asking the patient to match coloured pieces of yarn to standard pieces of yarn. The practitioner can get an idea of the patient's chromatic challenges based on the colours of yarn the patient has trouble matching[2].

Stereo vision testing

Lang Stereo Test

The Lang Stereo Test measures global stereopsis (third degree fusion) using pictures of familiar objects (a cat, star and a car). To appreciate the images floating off the page, the patient must be bifoveal, so this test is very sensitive in detecting small angle strabismus. The images vary in disparity, ranging from 600 to 200 arc seconds. The major advantage of the Lang Stereo Test is that polarised spectacles are not needed. This is helpful if the patient is averse to objects being placed on their face. The disadvantage is that the patient must be able to point to, or describe, the location of the objects[2,5].

Random Dot E Test

The Random Dot E Test also measures global stereopsis. This stereo test uses two targets and polarised spectacles to evaluate stereopsis. A raised model 'E' card should be shown to the patient as an example of the target. They should be allowed to feel the card so that they know what to expect throughout the test. Two test targets (one that is blank and the other containing the 'E') are then shown and the patient must choose which target has the letter 'E' on it[2,5].

This procedure can be performed at different distances in order to evaluate different disparities. For example, if the patient is able to correctly identify four out of six presentations at 50cm, this corresponds to a disparity of 504 arc seconds, whereas a distance of about 5m corresponds to a disparity of 52 arc seconds. This test is very useful for non-verbal patients, since they can simply point to the card with the floating 'E'. The disadvantage is that it requires the use of polarised spectacles[2,5].

Visual field testing

The goal of visual field testing in special needs patients is to uncover gross peripheral defects, and areas of constriction or neglect. Any visual field defect may be compensated for by a head turn or a shift in

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Figure 1a
A puppet is used for fixation while another is brought around the patient's head

Figure 1b
The position when the patient looks at the target is noted

posture. To assess the patient's visual field, the practitioner should sit in front of the child observing their visual response and holding a target (puppet or noise making toy). The practitioner will need an assistant to stand behind the child and present another toy (hand puppet) in arcs of all meridians (**Figure 1a**). This toy, and the assistant, must not make any noise. The position where the patient first detects the stimulus should be noted[1,2] (**Figure 1b**).

Accommodative assessment

Accommodative testing should be performed because many patients with special needs have reduced accommodation. Some medications may also cause decreases and shifts in accommodation.

Monocular Estimation Method (MEM) retinoscopy

MEM retinoscopy is an objective method to evaluate the accuracy of the accommodative response. An MEM card (**Figure 2**) should be selected that has words appropriate for the child's age and educational level (or pictures if the child is not reading). Every retinoscope has a method of attaching the MEM card to its head. Retinoscopy should be performed along both the horizontal and vertical axes. The amount of plus or minus needed to neutralise the motion of the reflex should be estimated, and then confirmed using a trial lens. The key to this test is the speed at which the lens is inserted and removed in front of the eye. It must be so quick that the lens is essentially moving off the eye as it is being inserted[2,6].

With motion indicates an accommodative lag, and against motion indicates a lead. MEM retinoscopy should be performed at the patient's habitual working distance or at the Harmon's distance (distance from the patient's elbow to the middle of the knuckle) for children. When performing this test, it is important to use normal room illumination. The expected value for MEM retinoscopy is +0.25D to +0.50D with a standard deviation of ±0.25D[2,6].

Eye movement assessment

Evaluating ocular motilities in the special needs patient is crucial due to the high incidence of ocular motor abnormalities found, for example, with nystagmus and strabismus. In order to assess eye movement skills, motilities, pursuits, saccades, and near point of convergence (NPC) tests should be performed[2].

Extraocular motility

To assess ocular motilities, the practitioner should stand at least 50cm away from the patient, who should be instructed to follow a fixation target with only their eyes. By placing a hand on top of their head to prevent head movements, a double H pattern should be slowly traced with the fixation target. The patient should be able to keep the target single and follow it in all fields of gaze. An over-action or limitation in movement should be noted[2].

Pursuit testing

The Southern California College of Optometry (SCCO) 4+ System for ocular motility can be performed to evaluate the patient's pursuits and saccades. This system allows the patient to sit instead of stand, which is obviously helpful for patients confined to a wheelchair or those with poor balance. A single target is used and moved in a smooth manner (at a rate of about two seconds per 20cm) horizontally, diagonally and then vertically. The patient is instructed to follow the target as accurately as possible. Grading is based on a simple one to four scale[7] (**Table 1**).

Saccadic testing

The procedure for evaluating saccades involves two targets. These are held about 40cm in front of the patient, separated by no more than 50cm. The patient then fixates on one and then the other target upon command. Each cycle should be repeated between five and 10 times. The accuracy, latency (time involved in initiating each saccade), and any head movement should be noted[7] (**Table 1**).

Figure 2
Examples of MEM cards (figures and words)

Table 1
Grading system used for evaluating pursuits and saccades via the SCCO method

Southern California College of Optometry (SCCO) 4+ System for Evaluating Oculomotility[7]

Pursuit ability: test binocularly; if deficient, test monocularly

- 4+ Smooth and accurate
- 3+ One fixation loss
- 2+ Two fixation losses
- 1+ More than two fixation losses or any uncontrolled head movements

Saccadic ability: test binocularly; if deficient, test monocularly

- 4+ Smooth and accurate
- 3+ Some slight undershooting
- 2+ Gross undershooting or overshooting or increased latency
- 1+ Inability to do task or any uncontrolled head movement

Normal latency of initiating a saccade is 120 to 180 milliseconds

Evaluating binocular posture

Due to the high incidence of strabismus in special needs patients, the binocular vision assessment is without a doubt one element of the examination which needs to be assessed as thoroughly as possible.

Direct observation

When the patient enters the consulting room, their gait, head and body posture, and eye movements should be observed. By watching the patient, the presence or absence of strabismus can be detected. Direct observation can confirm nystagmus, abnormal lid action, ptosis, epicanthal folds and facial asymmetries[8].

Bruckner Test

This test is useful in the detection and diagnosis of small angle deviations and amblyopia. Minimal patient cooperation is needed, making this test invaluable. The practitioner should stand approximately 1m away from the patient, who should be seated comfortably in dim illumination. The direct ophthalmoscope light is shone onto the patient's face so that both eyes are illuminated simultaneously and equally. The patient's red reflexes are compared while looking through the ophthalmoscope. If one eye has a brighter reflex, it is more likely to be strabismic or amblyopic[8].

Hirschberg Test

This test allows for an objective examination of binocular alignment. The practitioner is able to make a gross estimate of the magnitude of the deviation. Similar to the Bruckner test, minimal patient cooperation is needed. To perform the test, a penlight or transilluminator is directed toward the patient's nose at a 50cm test distance. The patient fixates at the penlight and the relative placement of the corneal reflexes in relationship to the centre of the pupils is evaluated. If the relative positions of the reflexes are symmetric and centered, it is assumed that no strabismus is present[2,8,9] (**Figure 3a**).

Most patients have symmetrical corneal reflexes with approximately 0.5mm of nasal displacement. A temporal reflex in one eye indicates esotropia (**Figure 3b**) while a nasal reflex suggests exotropia. An upward reflex suggests hypotropia of that eye, whereas a downward reflex suggests hypertropia of that eye. If the reflexes are asymmetric, the angle of deviation can be estimated. A 1mm difference between the reflexes equals approximately 22 prism dioptres[2,8,9].

Angle Kappa (Lambda) Test

This test allows for the evaluation of fixation of each eye under monocular conditions[2,8]. It is performed by observing the position of the reflex in relationship to the centre of the pupil. Angle Kappa is performed immediately following Hirschberg, at 30-50cm. The practitioner's penlight or transilluminator is held below one eye with the other eye closed. The open eye should be positioned on the patient's midline. The patient is instructed to look at the light. Their left eye is occluded and the practitioner observes the corneal reflex, estimating the displacement from the centre of the pupil. When the reflex is decentered nasally, an exo deviation is present. An eso deviation is noted by a temporal decentered reflex. An upward reflex indicates a hypo deviation, whereas a downward reflex indicates a hyper deviation. The procedure is then repeated for the patient's left eye. As with Hirschberg, 1mm is equal to approximately 22 prism dioptres. Comparison of the Angle Kappa and Hirschberg can be made, with any difference associated with reduced acuity possibly indicating eccentric fixation[2,8].

Krimsky Test

When the practitioner is uncertain about the estimation of the displacement in millimetres, the Krimsky Test can be performed. This test is performed after Hirschberg and Kappa tests, by placing a prism bar before the fixating eye. The practitioner should then find the prism amount that aligns the corneal reflex of the deviated eye, to the corneal reflex of the fixating eye. The magnitude and direction of the prism used to estimate the size of the deviation should be recorded[2,8].

Cover Test

The Cover Test procedure is similar for distance and near. The difference lies in the size of the target used. The Unilateral Cover Test (UCT) and Alternating Cover Test (ACT) are considered the gold standards for assessing binocular posture. Using an interesting target or a sticker on the nose will be helpful when performing the Cover Test for special needs patients. The UCT can help the practitioner detect a tropia. The practitioner will assess the direction, frequency and laterality of the eye turn. The ACT is used to measure the magnitude of the deviation or detect a phoria[2,8,9].

The UCT is performed by occluding one eye while observing the unoccluded eye for movement. An outward eye movement indicates esotropia, an inward eye movement indicates exotropia, an upward eye movement indicates hypotropia, and a downward eye movement indicates hypertropia. This procedure should be repeated for each eye three or four times to allow for an estimate of the frequency of the deviation[2,8].

If no movement is seen on the UCT, or the magnitude of a tropia requires determination, the ACT is used. The occluder is moved from one eye to the other and back again, observing the eye movement of the uncovered eye as the occluder is removed. An outward movement of the eyes indicates esophoria, an inward movement indicates exophoria, an upward movement indicates a hypophoria, a downward movement indicates a hyperphoria, and no movement indicates orthophoria. The ACT should be repeated several times to identify the direction and magnitude of any movement. Prism should be continually added until movement is neutralised and reversal (opposite movement) is noted. The base of the prism bar should be placed in the direction of the movement[2,8].

Expected value for the Distance Cover Test is one prism dioptre of exophoria with a standard deviation of ±1 prism dioptre. The expected value for the Near Cover Test is three prism dioptres of exophoria with a standard deviation of ±3 prism dioptres. Any deviation found on the UCT is considered abnormal[6].

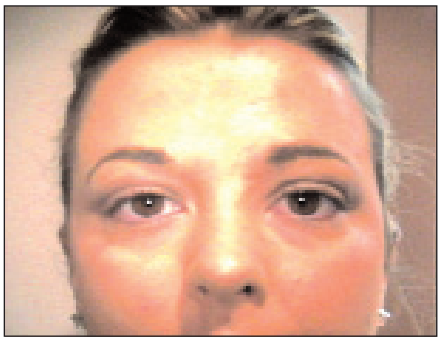

Figure 3a
A patient demonstrating symmetrical Hirschberg reflexes

Figure 3b
The same patient is demonstrating asymmetrical reflexes. A right esotropia is seen

Near Point of Convergence (NPC) Test

This test evaluates the patient's gross convergence potential. Testing the patient's NPC can be done objectively or subjectively. An interesting target is used and slowly brought toward the patient's nose along their midline (**Figure 4a**). The NPC break occurs either when the examiner notices one eye turning out or the patient reports diplopia (**Figure 4b**). The distance at which both eyes regain fixation of the target as it

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Figure 4a
Near point of convergence

Figure 4b
'Break' of convergence

Figure 4c
'Recovery' of convergence

is pulled away from the patient is the recovery (**Figure 4c**). The results of NPC are recorded as break and recovery in centimetres. The expected values for NPC are 6cm and 10cm, for break and recovery respectively[2,9].

Worth Dot Test

The Worth Dot Test measures second degree fusion. To perform this test, the patient wears red/green lenses over their correction. The patient views a light with four dots or a paediatric flashlight which uses an elephant, girl and a ball as a target (**Figure 5**). The test can be performed first in normal illumination and then in dim illumination to evaluate the depth of suppression[2,8,5].

The test is performed at 40cm and 6m. When the test is performed at 40cm, peripheral fusion is being evaluated. When the test is performed at distance, central fusion is being evaluated. A patient with normal binocular vision will see one red dot, two green dots, and will perceive the white dot as a mixture of red and green. A response of five dots indicates that the patient is diplopic. A response of either two or three dots indicates that the patient is suppressing the image from one eye. The test distance, room illumination and the patient's responses should be recorded.

A disadvantage of this test is that the intuitive patient can memorise the number and colour of the lights. In order to prevent this, the test can be repeated with a similar paediatric version with a three dot pattern or pictures[2,8,5].

Conclusion

As with any comprehensive eye examination, the patient's acuity, refractive error, accommodation, binocularity, fields, eye movement abilities and ocular health should be assessed. The techniques discussed in this article should serve as a template for an examination of a patient with special needs. The next part in this series will address the remaining aspects of the examination of special needs patients, including visual acuities and refraction.

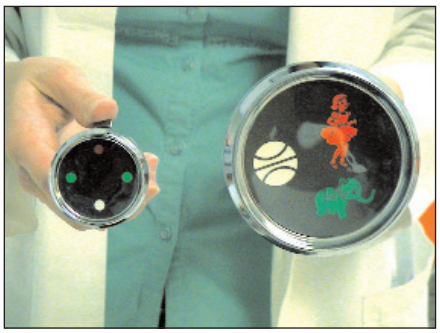

Figure 5
Two examples of Worth 4 Dots – traditional (left) and paediatric

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