An Orderly Approach to Assessing Strabismus

A simple pneumonic will help clinicians complete a full work-up in patients with suspected strabismus.

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Strabismus occurs in about 2% to 5% of the population.1 Proper diagnosis has several layers that reveal the nature of the eyes’ misalignment. Understanding strabismus is critical for proper clinical management. Because eye misalignment etiology can range from benign to malignant, it is important that eye care professionals thoroughly evaluate strabismus. The goal of this article is to provide a review of strabismus diagnosis procedures and to categorize them in such a way that makes strabismus testing more succinct.

ELEMENTS OF THE DIAGNOSIS

History
One area that is imperative for guiding the clinician toward making the proper diagnosis is case history. Uncovering information about the age of onset, frequency, associated factors, medical and ocular history, and family medical and ocular history provides a wealth of information for making a proper diagnosis. Because vision and development are intimately linked, developmental history is essential for a thorough case history.2 Questions regarding birth weight and timely achievement of developmental milestones may reveal crucial insight in determining management options.

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Observation
The examination of the patient with suspected strabismus begins with observation. Engage the patient while noting head posture, eye alignment, and eye fixation. These observations are important in understanding the visual behavior while establishing patient rapport.

Testing
Optimal correction and examination of ocular health are imperative for strabismus testing. The clinician should take care to provide the best prescription and to perform a dilated fundus examination and a cycloplegic refraction if indicated.

Strabismus affects the motor and sensory components of the binocular vision system. Therefore, both components should be assessed. The pneumonic to ensure all areas are examined is CAS: C = Comitancy
and Correspondence, A = Alignment, and S = Sensory fusion.

MOTOR EVALUATION
A thorough motor evaluation comprises alignment and comitancy.

Alignment
Alignment testing includes a cover test and a light-reflex test such as the Brückner test. The cover test is considered the gold standard for measuring ocular alignment.3,4 It is valuable because it reveals information about the direction, magnitude, and frequency of the deviation. Care should be taken to make sure the target used is at the appropriate level of visual acuity. Information gathered from the cover test is imperative, because it affects the prognosis and treatment options. For instance, a patient with a constant angle of deviation has a poorer prognosis than a patient with intermittent strabismus. There are, however, issues with the tests’ accuracy if the patient is uncooperative, particularly with patients younger than 2 years of age. Therefore, some clinicians prefer to use light-reflex testing. Light-reflex testing includes the Brückner, Hirschberg, and Krimsky tests. The Hirschberg test quantifies ocular misalignment by estimating the location of the Purkinje images on the cornea. The degree of misplacement, measured in millimeters, determines the angle of strabismus (Figure 1).

The Krimsky test takes the Hirschberg a step further by determining the amount of loose prism that will position the corneal light reflex in the center of the pupil. The amount of prism that centers the reflex is the magnitude of the deviation (Figure 2). Although efficient, reports in the literature have questioned the accuracy of the Hirschberg and Krimsky tests. Auochiche found that Krimsky measurements were consistently smaller than alternate cover test measurements.5 Likewise, Choi found that the Krimsky and Hirschberg tests were less accurate compared to the prism alternate cover test.4 The Brückner test simultaneously compares the red fundus reflex of each eye. The examiner must ensure that the patient is looking at the light source—the direct ophthalmoscope—to ensure the test results are valid. The brightness of each reflex is compared; the brighter reflex corresponds to the deviated eye.5 This test is a quick assessment that provides a lot of information in a short period of time. Some eye care professionals perform the Krimsky and Brückner test simultaneously to compensate for the inaccuracies of performing the Krimsky test by itself.5

Comitancy
Another aspect in evaluating the motor component is assessing the angle of deviation in all nine cardinal gazes to check for comitancy. If an eye turn is determined to be comitant, the magnitude of deviation is the same in all directions of gaze within 5.00 prism diopters. To determine comitancy, there are several test options, including a cover test in all directions of gaze, Maddox rod test, in all nine gazes, and the Lancaster red-green test. Because the images are dissimilar with the Maddox rod, fusional vergence is not permitted. Thus, this test can potentially uncover any latent deviations (Figure 3). The Lancaster red-green test is a dissociative subjective test that quickly measures comitancy in all nine gazes.6 It requires the patient to wear red-green glasses with the red over the right eye. The examiner directs a red light onto the screen, and the patient is directed to superimpose the green light on the red light. If the patient directs his or her light off to either side of the red light, this indicates the eye is deviated. The test is repeated for all directions of gaze. If the strabismus is deemed incomitant, it may be may be paralytic, mechanical, or restrictive. The clinician should consider performing ductions and versions to...
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reveal any extreme gaze limitations. If the extraocular muscle range of motion is reduced, forced duction testing is warranted to rule out a muscle restriction versus paresis or palsy.

Patients with strabismus have reduced accommodation and inaccurate fixations, pursuits, and saccades. Subjective oculomotility testing such as the Developmental Eye Movement test, King-Devick test, and the Northeastern State University College of Optometry Oculomotor test can give valuable information about the mismatch of where the eye is attending compared to where the target is located in space. Accommodative testing such as amplitude, lag, and facility enhance the examination. The clinician should exercise caution in administering these tests if the patient’s visual acuity is significantly reduced.

SENSORY EVALUATION

The sensory evaluation examines how the brain processes visual information. A thorough sensory evaluation comprises retinal correspondence and sensory fusion.

Correspondence

Normal correspondence occurs when the foveas of each eye are working together as corresponding retinal points. Those images are then fused in the brain allowing for single binocular vision. Patients with strabismus may develop an adaptation to prevent diplopia or visual confusion. Anomalous retinal correspondence occurs when the fovea of one eye is not a corresponding retinal point with the fovea of other eye. The nonfoveal point is interpreted in the brain as the visual center of the eye, which leads to misinterpretations of visual space.

The Bagolini striated lens test evaluates correspondence. The patient is asked to look at a penlight through clear striated lenses. For patients with normal binocular vision, the expected response is a cross with a single light in the center. If the patient sees this, yet either eye is deviated, he or she has abnormal retinal correspondence. This test does have limitations in that children younger than 8 years of age have problems noting their perception of the test.7 Patients with abnormal correspondence have a worse prognosis than those with normal correspondence. The Macula Integrity Tester and the After Image test are other methods for evaluating correspondence.

Sensory Fusion

There are a number of options to assess sensory fusion. Two common methods are the Random Dot Stereopsis (RDS) test and the Worth 4 Dot (W4D) test. The latter gives a wealth of information: presence of suppression or diplopia, the depth of suppression, posture of the diplopia, and the stability of the binocular system. The W4D displays four lights: two green, one red, and one white. A normal binocular response is perceiving four lights with the white light sometimes appearing reddish or greenish depending on ocular dominance. If the patient is suppressing, only two red dots or three green dots will be seen. If the patient notes five lights, two red and three green, this indicates diplopia. Patients with microtropia may note the four-dot response but not have normal binocular vision.8 The RDS is performed with the W4D because to appreciate the stereoscopic RDS image, the patient must fuse with both foveas attending the target. The RDS uses a global stereopsis target that does not give monocular or lateral displacement cues. Thus, patients with microstrabimus will not appreciate the forms. With a negative response to RDS, it is helpful to perform visuoscopy to determine if the patient has eccentric fixation.

CONCLUSION

Diagnosing strabismus requires several tests that enable the clinician to ascertain a concise clinical picture of the type of strabismus present. Because strabismus has benign and malignant etiologies, the examiner should be thorough in the testing sequence. The pneumatic CAS can guide the practitioner for each test category of strabismus.

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