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Dynamic Retinoscopy: The Missing Data

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Abstract. Dynamic retinoscopy is a well described but often overlooked technique that allows rapid assessment of accommodative ability. The key to the technique is the neutralization of the retinoscopic reflex that occurs when the patient accommodates on a target adjacent to the retinoscope. This clinical tool can provide critical data that can help solve treatment dilemmas, such as when a child presents with high hyperopia or when a patient presents at any age with possible accommodative insufficiency. In this review, performance of dynamic retinoscopy will be detailed, with the applicability of the technique demonstrated with use of case examples. (**Surv Ophthalmol 46:**269–274, 2001. © 2001 by Elsevier Science Inc. All rights reserved.)

Key words. accommodation • dynamic retinoscopy • esotropia • refraction

A 6-month-old boy referred for chronic overflow tearing has a cycloplegic refractive error of +5.00 D OU. Should you treat or observe? A 16-month-old girl has 1.75 D of anisometropia. Is she beginning to develop amblyopia? A 25-year-old woman complains of asthenopia and headaches that have persisted despite full recovery from a job-related hyphema 6 months previously. Near acuity is J1+ OU. Is she malingering?

The clinical situations above are often considered difficult treatment dilemmas. Why so difficult? The clinician is missing a key piece of information; namely, how well (and how symmetrically) can the patient accommodate in real-life situations? That missing information can be readily available with use of a well described[3,6] but often overlooked technique: dynamic retinoscopy. The purpose of this article is to review the performance and application of this valuable clinical tool.

Retinoscopy

During retinoscopy, the examiner views the red reflex of the eye through the peephole of the retinoscope while sweeping a linear streak of divergent light across several meridians. When the eye is focused in the plane of the peephole, all light returning from the retina passes through the peephole, and the red reflex appears to fill with light (neutralization, Fig. 1A). When the subject's eye is focused beyond the peephole (behind the examiner), only a portion of returning light passes through the peephole, and the red reflex appears as a band of light (the shape of the bulb filament) in the same meridian as that of the filament, moving in the same direction as the light source ("with" motion, Fig. 1B). When the eye is focused in front of the peephole, the band of light moves in the direction opposite the light source ("against" motion). For accurate determination of distance refraction, the patient is en-

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couraged to maintain a state of fully relaxed accommodation. This is accomplished through fixation on a distant target, or by using cycloplegia in some adults and most children.

For dynamic retinoscopy, cycloplegia is not used, and accommodation is not relaxed. The goal is to ask the patient to use accommodation to move the point of best focus (the point that is optically conjugate to the retina) at distance to the peephole of the retinoscope at near (Fig. 1A), without the use of additional lenses. This provides rapid and accurate assessment of accommodative ability in both eyes, as the examiner quickly switches back and forth between eyes. Several variations of the technique, some requiring plus lenses, have been described.[2,4,7,10] This report will describe techniques of dynamic retinoscopy that do not (for the most part) utilize additional plus lenses.

Dynamic Retinoscopy Technique

A near fixation target must be provided to perform the test. This typically consists of a small letter chart. Hold the target with the free hand, or secure it as close as possible to the retinoscope peephole without occluding the peephole or the light source (Fig. 2A). Seat the patient in the examining chair, with the room darkened to facilitate visualization of the retinoscopic reflex. Direct a dim light source (typically a dim reading lamp attached to the chair stand) toward the examiner so that the patient can see the near fixation target in the dim room. The patient should wear distance correction, except in special circumstances (for example, to determine how well the patient can function without glasses).

Ask the subject to fixate on a distant target. The retinoscopic reflex is assessed in both eyes, and "with" motion should be observed. Check several meridians in case astigmatism is present. Next ask the subject to fixate on the near target, with the retinoscope and target held approximately at the normal reading position. The "with" motion will rapidly change to neutralization or slight "against" motion. If neutralization is incomplete, try moving back slightly to see if accommodation is borderline, or encourage the patient to try harder (looking at finer print, for example). The examiner, retinoscope, and target should move together as a single unit. Switch back and forth quickly between the two eyes during the assessment. Avoid off-axis viewing, which can produce misleading responses. Again ask the subject to fixate on the distant target. The reflex should rapidly convert to "with" movement. Now move closer (Fig. 2B) and ask the subject to maintain fixation at near for a longer period of time. This places more demands on the accommodative system, which helps estimate whether the accommodative effort is sustainable.

The results of dynamic retinoscopy, when normal, can be described as "rapid, complete, and steady OU." Examples of abnormal responses can thus include "incomplete," "sluggish," "momentary accommodation only," "accommodative lag," or "asymmet-

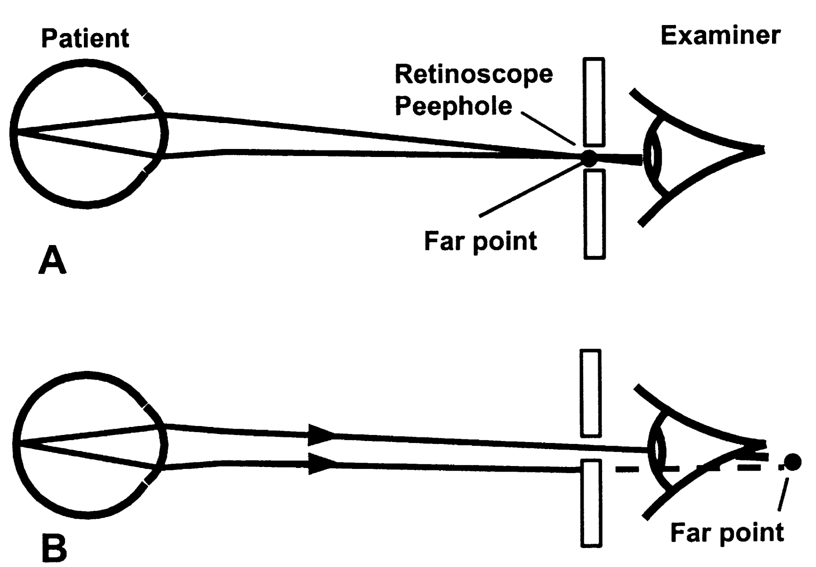

Fig. 1. Schematic representation of standard retinoscopy. The light source illuminating the eye is not shown, but is assumed to be a linear streak of divergent light produced by the linear filament of the retinoscope. The return path of light from patient to examiner is shown *A:* At neutralization, the far point of the eye is at the peephole of the retinoscope; all returning light passes through and the entire pupil appears to fill with light. *B:* When the far point of the eye is behind the examiner, a portion of returning light is blocked by the retinoscope peephole; reflected light thus appears in only part of the pupil, and "with" motion is observed as the streak is swept across the eye.

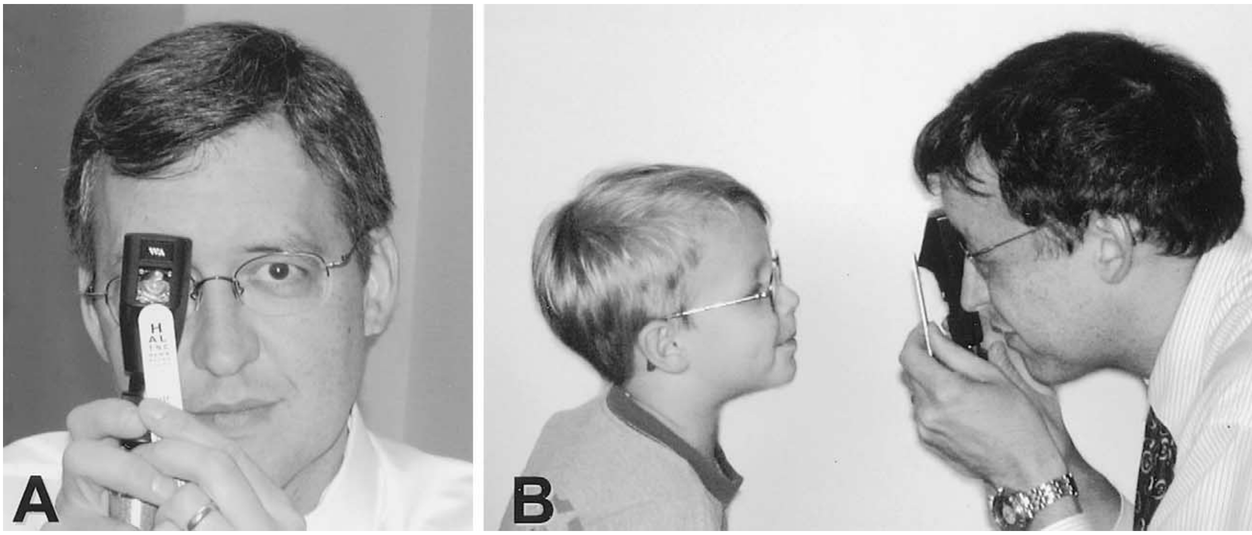

Fig. 2. Dynamic retinoscopy. *A:* A fine target, such as a small letter chart, is placed adjacent to, but not occluding, the retinoscope peephole and light source. *B:* The examiner attracts attention to the accommodative target and evaluates the retinoscopic reflex in both eyes. In this case, the examiner has moved quite close to the patient to further stress the patient's accommodative system.

ric." Dynamic retinoscopy can thus be performed, and the results recorded, in seconds. If possible, dynamic retinoscopy should be performed routinely on new patients prior to cycloplegia to avoid the need for a postcycloplegic evaluation.

Alternatives and Limitations

There are potential alternatives to dynamic retinoscopy, but each has disadvantages. Near acuity measurement provides some indication of maximal accommodative ability, but it does not provide any indication of the effort required to read the letters, and it is subject to errors if the wrong testing distance is used or an improper add is given. Formal measurement of accommodative amplitudes is time consuming and must be performed monocularly, making it impossible to compare the accommodative state of the two eyes simultaneously. Measurement of accommodative amplitudes provides no information about the time required to achieve the endpoint or of the stability of the endpoint. These tests are unreliable and time-consuming when performed on older children, and not applicable to preverbal children.

All assays of accommodation, including dynamic retinoscopy, may generate false responses. Falsely abnormal results are obtained if a subject is inattentive or uncooperative. This can be avoided by strongly encouraging the patient to attend to a near target with fine detail. Falsely normal results can occur if a patient with accommodative insufficiency is able to generate an accommodative response for the duration of the test, but is unable to maintain this level of accommodation for extended time periods when reading at home. A false normal result is less likely to occur if the patient is asked to maintain focus on the near target for several seconds during testing; patients who are symptomatic generally are not able to maintain near focus for long under the intense demands of dynamic retinoscopy.

Near retinoscopy is used to measure distance refraction, not accommodation. This technique, described by Mohindra et al,[9] should not be confused with dynamic retinoscopy. Near retinoscopy is performed under monocular conditions. The retinoscope filament serves as the target. Under these circumstances, there is normally no accommodative stimulus (but see the section Infants, below). The distance refraction is estimated empirically by subtracting 1.25 D from the value obtained.

Special Situations

CHILDREN

It may be necessary to ask the patient to read the letters out loud or to name a detail in a small picture to stimulate accommodation. It is best to avoid questions such as "what color is the bird," for these questions will stimulate cogitation rather than accommodation. Instead, ask for observational detail: "How many toes are on the bird's feet?"

ACCOMMODATIVE LAG

If the conversion of the "with" retinoscopic reflex to neutralization at near is equivocal, try separating the target from the retinoscope, moving it closer to the patient while keeping the retinoscope in the same place. This should generate additional accommodative effort and produce unequivocal "against" movement. If the target must be moved more than 1–2 cm in front of the retinoscope to achieve neutralization, the patient may be demonstrating clinically significant "accommodative lag," that is, the patient is able to accommodate, but not able to generate sufficient accommodation to focus accurately on the near target.

ASTIGMATISM

In all patients, initially assess the reflex in multiple meridians to identify significant astigmatism. When uncorrected astigmatism is present, the near reflex will remain "with" in some meridians, and be neutralized or even switched to "against" in other meridians. When astigmatism is observed, it should be quantified with a standard refraction.

INFANTS

In infants, dynamic retinoscopy is performed by assessing the response to an appropriate near target only; there is no need to assess the change in the reflex during fixation on a distant target. At this age, there still may be little interest in the standard pediatric accommodative targets, and little accommodative ability may be detected before 2–4 months of age.[5,11] Larger squeaky toys may help create interest. Two maneuvers that may go against common clinical judgment are useful when an infant appears to show no accommodative response to a target. First, move closer. Recall that babies have a high capacity for accommodation but little interest in remote targets. Up to age 4 months, the accommodative response may be all or none, with neutralization noted at a distance of just 0.2 m in some cases. Second, try using a small fixation light as a target. Although a white light is not a good accommodative target in older children under monocular conditions (see Near Retinoscopy, above), in our experience it is quite a good accommodative stimulus for infants when viewed binocularly.

Case Examples

How can we use dynamic retinoscopy to solve a variety of clinical dilemmas? Consider the following examples.

CASE I

A 6-month-old boy referred for chronic overflow tearing has a cycloplegic refractive error of +5.00 OU. There is no strabismus. Should you treat or observe?

Dynamic retinoscopy can be reassuring in these cases. If this boy can accommodate normally at near while maintaining centered corneal light reflexes, frequent observation alone is probably safe. If accommodation is insufficient, repeat the assessment through partial hyperopic correction. For example, start with +2.00 lenses; if accommodation is still insufficient, try increasing the amount of plus power in 1- to 2-D increments until the patient is able to neutralize the reflex at near. Consider deferring glasses until similar measurements have been obtained on more than one visit. If the patient cannot accommodate to a near target (by dynamic retinoscopy) without the aid of partial hyperopic correction on consecutive visits, prescribe glasses.

In my experience performing dynamic retinoscopy routinely on highly hyperopic infants and children over the past 10 years, I have found that many high hyperopes develop a strategy for avoiding esotropia while accommodating 8–15 D to view near targets. These children will accommodate fully, but only briefly, on the near target; presumably they accommodate just long enough to identify key features of the object of interest. Once the object has been evaluated, the child will immediately relax accommodation. This might be considered an "accommodative burst" adaptation. The response is recorded as "rapid and complete, but momentary." As they grow, these patients tend to either 1) require partial hyperopic correction if the hyperopia does not change, or 2) become less hyperopic, thereby avoiding the need for glasses.

If dynamic retinoscopy had not been assessed prior to cycloplegia, the patient will need to return for a postcycloplegic evaluation before a treatment decision is made. Consider this a good opportunity to warn the parents that glasses may be in the child's future. Parents do not react favorably to the idea that their normal-appearing child may need glasses, and spreading the shock out over several visits reliably defuses the reaction.

Similarly, newborn babies may have high hyperopia, discovered incidentally. Infants have not yet learned to accommodate accurately,[5] and dynamic retinoscopy may therefore be unreliable. In the absence of strabismus, it is reasonable to defer assessment of accommodation and prescription of glasses until 4–6 months of age, depending on severity.

CASE II

A 4-month-old girl presents with an extensive anterior polar cataract in her right eye. There is no view of the posterior pole prior to dilation, but a good, clear view after dilation. Intraocular surgery can probably be avoided if chronic dilation is tolerated. How frequently should the dilating drops be instilled to avoid inducing refractive amblyopia while still adequately dilating the pupil?

In this case, chronic pupillary dilation is desired to allow a formed image to reach the retina. A noncycloplegic dilating drop is unlikely to keep the pupil dilated for long enough to be useful. However, a cycloplegic agent will paralyze accommodation, thereby optically penalizing an eye that is already amblyopic. Bifocals could compensate for the cycloplegia, but they are difficult to manage effectively in such a young patient. One treatment approach in this case would be to administer a dose of the cycloplegic agent, then follow the patient with dynamic retinoscopy every 1–2 days for 1 week to determine 1) when the cycloplegic agent had worn off sufficiently to allow good near vision, and 2) when the dilating effect had worn off sufficiently to again obscure the entrance pupil. Drops could then be prescribed on a time interval that maximized the number of days with dilation but without cycloplegia. For example, if one drop of atropine to the right eye gave 1–2 days of total cycloplegia, 3 days of dilation with only partial cycloplegia, and 2 days of full accommodative ability but marginally dilated pupils, the parents might be advised to instill one drop of atropine to the right eye every 5–7 days, combined with part-time occlusion of the left eye on days 2–6.

CASE III

A 5-year-old boy with hyperopic anisometropic amblyopia OD is treated with glasses and atropine penalization of the left eye. Cycloplegic refraction is OD +3.50 sphere, OS +0.50 sphere. Is a bifocal also necessary to help the amblyopic eye focus at near?

An amblyopic eye tends to accommodate poorly, especially when the eye has significant hyperopia. Thus the question, "Is a bifocal necessary?" frequently arises when treating these patients. The use of atropine penalization increases the relevance of the question, since the amblyopic eye will be responsible for fine near work. Dynamic retinoscopy with best distance correction in place and a cycloplegic agent instilled in only the penalized eye can answer this. If the amblyopic eye does not accommodate reliably, a bifocal lens should be prescribed only for the amblyopic eye until later testing reveals improved accommodation in that eye.

CASE IV

A 16-month-old girl has 1.75 diopters of hyperopic anisometropia. Is she beginning to develop amblyopia?

Although accommodative effort is generally symmetric, we do not know in this case whether the child is always accommodating with the less hyperopic eye (and thus probably already amblyopic or at high risk), or whether she is spontaneously accommodating with the more hyperopic eye at times (and thus at lower risk for amblyopia). Dynamic retinoscopy can be performed with particular attention paid to the more hyperopic eye. If the eye cannot accommodate even under monocular conditions, it is probably amblyopic. If it is consistently hypoaccommodating, then the anisometropic correction required to restore symmetry should be prescribed, and prophylactic, part-time occlusion or penalization should be considered (especially if glasses are refused). Alternatively, if the eye shows evidence of full accommodation to a near stimulus when viewing under binocular conditions, observation alone is acceptable.

CASE V

A 6-year-old girl complains of tiring after reading for a few minutes despite near acuity of J1+ in each eye, normal convergence, and a cycloplegic refraction of +1.50 OU. Are her complaints fictitious?

Measurement of normal J1+ near acuity alone in this patient does not fully characterize her accommodative status. Dynamic retinoscopy might reveal rapid, complete, but unsteady or discontinuous accommodation in this low hyperope, confirming the diagnosis of accommodative insufficiency and reinforcing the decision to treat with glasses. Alternatively, a briskly normal dynamic retinoscopy response is consistent with a nonocular etiology to her complaints. If symptoms persisted in the latter case, a trial of a low-power reading add may be indicated in case of a falsely normal response to dynamic retinoscopy.

CASE VI

A 5-year-old boy presents for follow-up of high hyperopia, accommodative esotropia, and amblyopia. Three siblings, aged 4 months, 16 months, and 3 years, accompany him. Mother wants the other children evaluated formally for amblyopia on a future visit, but the family has no insurance and must pay out-of-pocket for every exam. Which child should be examined first?

Dynamic retinoscopy can be used as a quick screening tool for potentially amblyopiagenic refractive error. By using an accommodative target and quickly switching back-and-forth to view the reflexes in both eyes, it is possible to detect refractive asymmetry or high hyperopia with poor accommodation. Significant astigmatism can be detected with or without use of an accommodative target. Esotropia induced by accommodation can also be detected. In this case, all three siblings can be screened in seconds, and any child with abnormal findings should be examined promptly.

CASE VII

A 7-year-old boy with Down syndrome has a cycloplegic refraction of +0.75 OU. There is no strabismus, and he is asymptomatic. Are bifocals indicated?

Patients with Down syndrome have poor ability to sustain accommodation.[1,4] Patients with other developmental delays may be similarly affected.[8] There is a high likelihood that this child will need bifocals, even though the hyperopia is minimal. Dynamic retinoscopy, performed prior to cycloplegia or on a follow-up visit, can help determine whether this patient will benefit from a bifocal add. We have found that patients with Down syndrome often accept glasses much more readily when bifocal adds are included.

CASE VIII

A 25-year-old woman complains of asthenopia and headaches that have persisted despite full recovery from a job-related hyphema 6 months previously. Near acuity is J1+ OU. Is she malingering?

Ocular trauma can impair accommodation. Often but not always heralded by pupillary abnormalities, the problem can sometimes be confirmed by formal measurement of accommodative amplitudes, but it might be missed if accommodation is complete but slow or unsteady in the traumatized eye. More rapid and accurate confirmation can be achieved with dynamic retinoscopy, with which the trauma-induced subnormal accommodation of the right eye can be detected by rapidly comparing the state of accommodation in the two eyes.

In this patient, if unilateral accommodative insufficiency is detected, the patient may benefit from a monocular bifocal add. If dynamic retinoscopy is normal, a nonocular etiology to the symptoms should be sought.

Summary

With dynamic retinoscopy, neutralization of the retinoscopic reflex can be detected bilaterally when the patient accommodates on a target adjacent to the retinoscope. This rapidly performed clinical tool can provide critical data that can help solve diagnostic or therapeutic dilemmas involving high hyperopia or possible accommodative insufficiency.

Method of Literature Search

The MEDLINE (www.ncbi.nlm.nih.gov/entrez/medline.html) database was searched using the dates 1966 to the present using the phrase *dynamic retinoscopy*. No limitations on language were applied. In March 2001, the search yielded 29 articles. Additional relevant articles were identified from the references cited in the articles found with the MEDLINE search. The Association for Research in Vision and Ophthalmology Abstract Search and Program Planner was also searched. Articles and abstracts considered of highest relevance to the topic were included in this article.

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