

THE DYNAMIC RETINOSCOPIES

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Abstract

Dynamic retinoscopy techniques have long been a part of standard optometric practice. Over time numerous techniques have been added and methods have been modified. The purpose of this paper is to provide some background into the various techniques as to purpose, standard methodology and application. The student or new practitioner is often puzzled by the number of possible retinoscopy probes and the one to apply for a specific patient. In addition many optometrists have lost sight of the value of any or all of these techniques. It is hoped that this review will enable more students and optometrists to use and understand these valuable techniques.

Key Words

cognitive demand, dynamic retinoscopy, lag of accommodation, lens prescribing

INTRODUCTION

It became apparent to me and fellow educators of the need to better explain the plethora of tests collectively known as near or dynamic retinoscopy. Some practitioners and students may be unaware of the development of these tests. Further, some may wonder why so many variations have evolved of what appears at first glance the same clinical probe. It is noteworthy that while the basic premise and procedure for each of these tests have remained fairly constant, variations have evolved. This paper addresses these issues to facilitate the understanding of the tests and enlighten the readers to the use of these respective techniques.

A Brief History of Dynamic Retinoscopy

The retinoscope is actually an outgrowth of the ophthalmoscope. In 1861, William Bowman noted the changes in light and shadow that occurred within the pupillary border when he tilted his ophthalmoscope. Meagan publicized the method while Parent introduced the application of lenses to allow a quantitative measurement rather than simply a qualitative judgement.¹ (pp. 659-95) The basic principle is Foucault's knife edge method of determining the focal power of a lens with the refractive status of the eye being considered an unknown lens.² Thus, in theory, the refractive power of the eye can be determined by locating its conjugate focus in space. In practice, the concept works much better with an optical bench than with a human eye. The first application of retinoscopy was the objective and quantitative determination of the distance refractive status (static retinoscopy) with accommodation either inactive or with

limited variability. The static retinoscopy technique is performed with the patient fixating a target placed at optical infinity or with accommodation otherwise relaxed. The basic mechanics of retinoscopy and explanation of the various motions are comprehensively and clearly explained elsewhere.¹ (pp. 659-95)

Starting in the early 1900s, various investigators began utilizing the retinoscope to determine the amplitude or status of accommodation in non-verbal patients. It was during this time the term *dynamic retinoscopy* emerged.¹ (pp. 697-713) It has come to mean a retinoscopy technique performed where the patient fixates a near object but should not be confused with *Mohindra Retinoscopy*. The Mohindra Retinoscopy is performed at near on infants or very young children. In this procedure the subject monocularly fixates on the light from the retinoscope, but the object of the test is to estimate the infants' refractive condition at distance.²

A.J. Cross³ is credited with introducing the basic theory and method for dynamic retinoscopy. Others who elaborated on the theory and procedure were Sheard,⁴ Nott,⁵ and Skeffington.⁶ Once the technique became more popular, some optometrists developed variations based on their particular model of vision.

Aside from the initial goal of using dynamic retinoscopy to determine accommodative response, the goals of various techniques came to include factoring in the near phoria. It also helped determine the most appropriate near prescription with testing conditions ranging from minimal to more complex cognitive demands. The two major variables in these tests are the clinical purpose and the level of cognitive demand. Cognitive demand

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is inferred by the task the patient is asked to perform while the retinoscopy is being completed. Consequently, a number of procedures have evolved based on the interplay of these variables. Some of these techniques will be discussed with regard to: purpose, cognitive demand, materials, procedure, interpretation and clinical utilization. (Table 1) None of these techniques are designed to determine the accommodative amplitude.

I. Monocular Estimate Method (MEM) Retinoscopy

Purpose and Cognitive Demand

This technique was attributed to Dr. Harold Haynes at the Pacific University College of Optometry.⁷ It is a method that gives an estimated measure of the spatial positioning of accommodation with regard to where the eyes are postured in space (convergence). Thus, there can be a lag, a lead, or the two visual components can be coincident. The cognitive demand is moderate.

Materials and Procedure

A spot retinoscope or streak retinoscope with the sleeve in the down position is the basic instrument. The targets used here are a series of cards with a central aperture, mounted on a retinoscope. The cards can have printed letters, or words, or pictures that range in size from 20/160 (6/120) to 20/30 (6/9). The targets are arranged around the aperture in a manner that facilitates the examiner's position so that retinoscopy is performed as close as possible to the visual axis.

The patient is seated. The target on the retinoscope at 40 cm (16 inches) from the patient or, in some cases with a child, is at the patient's Harmon distance. The patient wears their compensating lenses. This procedure is termed "monocular" because only one eye is scrutinized during the testing; however, both eyes are open. The patient is instructed to keep the targets clear. Often the examiner may request that the targets be read aloud to induce a greater cognitive demand.

The examiner sweeps the retinoscope beam across one of the patient's eyes and observes the motion of the retinoscopic reflex. An estimate of this dioptric movement is made and then the examiner quickly interposes a trial lens at the spectacle plane that is deemed sufficient to neutralize the reflex motion.

The examiner should take care that the inserted lens changes the accommodative response as little as possible. This technique

Table 1. Summary of Dynamic Retinoscopy Techniques

Test	Aspect assessed	Cognitive demand	Target location	Expecteds
Monocular Estimate Method (MEM)	Positioning of accommodation relative to convergence	Moderate	16 inches (40 cm) or Harmon distance for some youngsters	+0.50
Nott Dynamic	Positioning of accommodation relative to convergence	Moderate	16 inches (40 cm)	+0.50
OEP #5	Positioning of accommodation in space	Moderate	16 inches (40 cm)	Evaluated in comparison to test #7
Bell Retinoscopy	Positioning of accommodation relative to convergence	Low	20 inches (50 cm) at start of testing	With motion at 14-17 inches changing to against motion at 15-18 inches
Stress Point (Krasnik)	Response to stress	Moderate to high	20 inches (50 cm) at start of testing	Stress point at least 10 cm closer than Harmon Distance
Book (Getman)	Level of Visual Processing	High	Habitual Near Working Distance	Task related

requires leaving the lens in place for less than one full second. This technique is then repeated on the fellow eye.⁸⁻¹⁰

Interpretation and Clinical Utilization

In most cases, there will be a "with" reflex (assuming the use of a spot retinoscope or a streak retinoscope with the sleeve in the down position) corresponding to accommodation postured farther from the patient than the stimulus.¹⁰ The amount of the "lag of accommodation" is the amount of plus lens that neutralizes the reflex. A key here is that the amount of lens is estimated based on the amount of movement observed.

Although color and brightness changes will be apparent in the majority of observers, this is not part of the evaluation.¹¹ A number of studies have been performed to validate this technique. MEM has been found to accurately measure the lag of accommodation in an objective manner.¹²⁻¹⁹

II. Nott Dynamic Retinoscopy

Purpose and Cognitive Demand

This was developed by I. S. Nott in the 1920s.²⁹ The main purpose is identical to the MEM method, to give an objectively measured estimate of the spatial positioning of accommodation with regard to where the patient is converged at the same time. The cognitive demand is moderate.

Materials and Procedures

A reduced block of 20/20 (6/6) letters is placed at 16 inches (40 cm) from the pa-

tient. The procedure was first performed in and more recently, both in and out of the phoropter. The patient wears his compensating distance lenses and is directed to read the letters. The examiner performs retinoscopy by moving farther from the plane of regard until the motion is neutralized. The dioptric difference between these two distances equals the lag of accommodation. It is performed on each eye separately.²¹

Interpretation and Clinical Utilization

As with the MEM procedure, in most cases, there will be a "with" reflex corresponding to accommodation postured farther from the patient than the stimulus. In addition to the measured accommodative lag, this method can be valuable in evaluating the stability of the accommodative response. This method is frequently studied with and compared to the MEM method.^{12,14-26}

III. Analytical Sequence Dynamic Retinoscopy (#5 and #6)

Purpose and Cognitive Demand

These two techniques (#5 and #6) are identical except for the distance where they are performed. Very few optometrists perform the #6. Only the #5 procedure will be described here. This technique was developed in concert by a number of optometrists but was heavily influenced by the input of Dr. A. M. Skeffington.⁶

The purpose of the procedure is not to prescribe the measured value but as a key finding in the analysis of "syndromes." Depending upon the syndrome found, the comparison of the #5 to other findings allowed the modification of the lens recommended for both distance and near wear. The cognitive demand is moderate.

Materials and Procedure

The target is a block of 20/40 (6/12) letters or slightly larger if acuity demands. The letters are ideally arranged around an aperture to facilitate retinoscopy on or close to the visual axis.

The instructional set follows.

The lens power in the instrument would be found by the distance retinoscopy finding (the #4). The operator positions himself 20 inches (50 cm) away. The fixation target consists of a group of small letters in close proximity to and in the plane of the retinoscope. The patient's attention is directed to the letters and he is again asked to read the various letters that the examiner indicates. Enough plus is added bilaterally to the distance retinoscopy finding to cause a definite against motion in all meridians.²²

While the patient actively observes the target the examiner sweeps the 180th meridian with a single, continuous motion of the retinoscope, noting successively the right and then the left reflex. With added plus power in place, "against" motion of both reflexes is anticipated. If this is not the case, increase the plus bilaterally until the 180th meridian of both reflexes shows "against" motion. Reduce plus in 0.25 D steps, bilaterally, until "neutral" or "with" motion is produced. If one reflex neutralizes sooner than the other, continue to reduce the plus unilaterally on the unneutralized side. Record the lenses which first give "neutral." If there is no "neutral" (the reflexes go from "against" directly to "with"), then record the last lenses which gave "against," as the #5 finding.

Interpretation and Clinical Utilization

The #5 retinoscopy finding has no specific meaning by itself until it is compared to other findings as part of the total analytical examination. In many cases, the #5 will approximate the most plus lens that is acceptable at near. The patient, if given time to acclimate to the lenses, may "free up" more accommodation resulting in more plus acceptance. The resultant power gives an indication of the amount of plus acceptable at near in addition to the distance pre-

scription. It is not meant to be interpreted by itself or to determine the amount of the accommodative lag. This method has not been the subject of extensive independent study.

IV. Bell Retinoscopy

Purpose and Cognitive Demand

This method was developed over time, mainly by Drs. W.R. Henry and R.J. Appel.^{23,24} It gives an estimated measure of the spatial positioning of accommodation with regard to convergence. Thus, there can be a lag, lead, or the two visual components can be coincident. It also allows the examiner to view the results of changes in this relationship when wearing a lens at near. The cognitive demand is low as the patient passively observes the target as it moves.

Materials and Procedure

Perhaps the most marked difference between this technique and previously discussed techniques is the use of a three dimensional viewing target. The retinoscope remains in a fixed position and the target is moved.

This procedure was named for a small, highly reflective bell dangling from a string that was used as a fixation target. In practice, the bell has generally been replaced with a Wolff Wand^a (a reflective, gold or silver, 1/2 inch diameter, metal ball mounted on the end of a rod) or a translucent sphere. The wand is held by the examiner so that the ball is at the patient's eye level and midway between the two eyes. The ball will be moved closer to and farther from the patient along this midline. The retinoscope is positioned slightly above this line at a fixed distance of 50 cm. (20 inches) from the patient. (Figure 1)

The patient fixates the target and the examiner notes the direction of the reflex with slight movements of the retinoscope. The ball is moved toward the patient slowly and smoothly. Note any changes in the reflex. The examiner primarily observes the motion of the reflex, but color and brightness changes can also be observed. The distance of the target from the patient when neutrality is seen is recorded when a change in motion, color or brightness is observed.

Interpretation and Clinical Utilization

With a hyperopic patient or a person wearing compensatory lenses matching the distance refractive status we expect to see a "with" motion at the beginning of Bell Retinoscopy. As the target is moved

closer to the patient there will be a point where the motion changes from "with" to "against." The examiner should continue to move the target closer to the patient another three to five cm. (1 - 2 inches) then move the target away from the patient. The "with" motion should again be seen at some point.

Conceptually, the lag of accommodation as a linear measurement is being evaluated rather than with lenses. The distance between the retinoscope and the target when the motion change occurs is a physical measure of the lag of accommodation. Typically we expect to see a change from "with" to "against" at or about 35 - 42 cm. (14 - 17 inches) and a change from "against" to "with" at 37 - 45 cm. (15 - 18 inches). If the lag of accommodation does not fall within these ranges, the procedure is repeated with various probe lenses of relative plus power until a lens combination provides the desired change in spatial location.

Lenses that normalize these ranges are considered an acceptable near point prescription. Do not merely assume that a lens calculated from the Bell Retinoscopy measurements will have the desired effect. One should actually repeat the test with the suggested add, new anisometropic correction or cylinder in place.

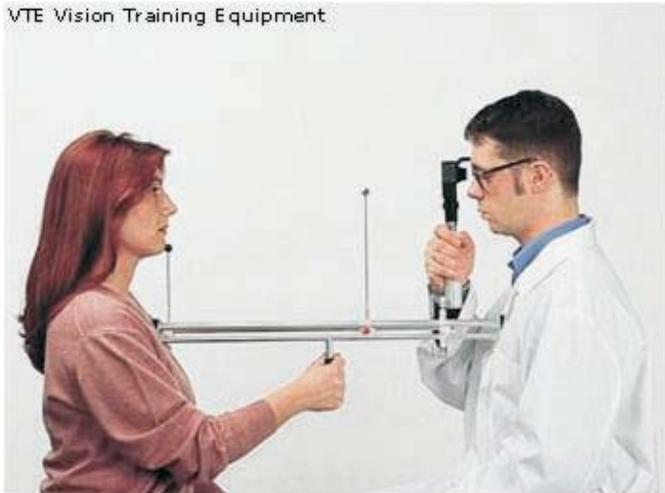
For example, it is possible at the beginning of the procedure to find against motion even at 50 cm indicating over-accommodation. It is then appropriate to add plus lenses and re-perform the procedure. If the lenses lead to relaxation of accommodation, a more normal reflex is seen. The data gathered here is somewhat similar in purpose to the Analytical Sequence Dynamic Retinoscopy but it does not require comparison to other findings.

V. Stress Point Retinoscopy

Purpose and Cognitive Demand

This technique was suggested by Darell Boyd Harmon, Ph.D. and brought to fruition by Dr. Robert A. Kraskin.^{25,29} Although it appears to be a similar technique to other methods, it is actually a radically different concept. The other techniques measure the patient's accommodative mechanism to learn how to alter accommodation. Stress Point Retinoscopy purports to evaluate the response of the entire organism to stress. This is especially true at that level of stress that exceeds the capabilities of the organism. At the stress point, as the reaction of the organism changes from fight (trying to manage the

Figure 1. A Device for Facilitating Bell and Stress Point Retinoscopy



The Bell can slide either closer to or further from the patient. Reproduced with permission from Vision Therapy Equipment (VTE)

demand) to flight (abandoning the attempt to meet the demand level). The cognitive demand is moderate to high as the target is invading the patient's space.

Materials and Procedure

The technique is performed with the habitual prescription in place in free space³¹ as the patient observes a Wolff Wand held directly above the retinoscope, just outside the patient's Harmon Distance. With Stress Point Retinoscopy the retinoscope is not moved but rather is held stationary, centered on the pupil of the patient's eye. The target is moved toward the patient. (Figure 1.) Changes in luminance are observed. There should a very brief large increase in the brightness of the reflex that is often very difficult to see, followed by a "dulling" of the reflex as this point is passed. This second reflex is much easier to see as it becomes the new baseline luminance. The procedure is repeated a number of times through various probe lenses (bilaterally similar low plus lenses) and the different distances are recorded where the stress point change occurs through each lens.

Interpretation and Clinical Utilization

As the wand is brought towards the patient, inside the patient's Harmon distance, the patient must change how they are seeing, to remain engaged with the target. In different patients this is accomplished in different ways. Some may show outward signs of increased effort, some may only show a shift in the vergence position of the eyes with little or no other observable shifts, some may show pupil changes.

With Stress Point Retinoscopy, the clinician is measuring a volume of space inside the patient's Harmon distance where the visual process is active. During this "on" or "engaged" phase, the reflex remains bright, although there may be a slight sense of increased brightness the closer the target approaches the stress point. The stress point then defines the inner limit of space where vision is functionally comfortable. Dr. Kraskin felt that one

observes ONLY brightness changes and color changes are merely a side effect of brightness changes.²⁸

The validity of evaluating changes in the brightness of the retinoscopic reflex was demonstrated elegantly in 1977 in two studies by Kruger.^{29,30} In those studies a photo-electronic retinoscope was used, attached to a photometer rather than a human observer. Kruger concluded that the changes were due to changes in accommodation. However, an alternative explanation has been proposed that the cause of the shift in luminance may be a change in the reflectance of the retinal tissue in response to the neurological response from fight to flight.³¹ Individual nerves cells do change reflectance roughly proportionally to the frequency firing of action potentials.³¹

The point between the examiner and the patient where this change occurs is the point where the individuals' visual behavior apparently shifts from fight to flight. The distance where the change occurred is noted. Probe lenses are then introduced to change shift this stress point. The goal of this procedure is to find the lens that brings the stress point closest to the patient. Very low powered plus lenses tend to shift the stress point closer to the patient. At some point, the stress point stops shifting closer to the patient and will actually begin shifting outwards from the patient. Kraskin considered the lens that brought the stress point closest to the patient, the optimum lens and often prescribed this as the near lens. Thus, instead of looking for an optical phenomena, this technique allows

the optometrist to gain insight into where stress begins for the individual.

VI. Book (Getman) Retinoscopy Purpose and Cognitive Demand

Book Retinoscopy was developed at the Gesell Institute of Child Development at Yale University. While numerous optometrists and other professionals aided in its development, it is most identified with Dr. Gerald Getman.³² Originally, this type of testing was developed to obtain information about the visual processing of non-verbal infants. Later optometry began to apply the technique with many types of patients. Kruger's^{29,30} work is quite supportive of this method of retinoscopy. Its major purpose is to evaluate the subject's cognitive processes when reading. The cognitive demand is high.

Materials and Procedure

This technique is performed at the patient's habitual near working distance while their habitual compensatory lenses are worn. The patient is given reading material at varying levels of difficulty. Retinoscopy is performed over the top edge of the material, as the subject reads aloud. One should start two grade levels below the child's reading level. Alternatively, a series of cards (usually from the Gray Oral Reading Test) can be used. The test is meant to be performed at the child's habitual near working distance.³³ The advantage of this technique is that information is gathered in real time with a task that is close to their normal work situation. The examiner should strive to stay as close as possible to "on visual axis" while the child reads.

Once the reading level baseline is obtained, plus lenses over and above the distance findings are used to see if changes occur. The amount of plus can be based on other test results such as the fused cross cylinder or a practitioners own "standard" probe lenses.

Interpretation and Clinical Utilization

Getman and Kephart described the following response levels with this technique:³⁴

- A. Free reading level: Desirable, The reflex varies from neutral to with and is bright and sharp and pinkish. At this stage the subject is reading and comprehending the material easily.
- B. Instructional level: This is more demanding than the free reading level. The reflex is a varying, fast against motion while the color is bright, sharp, very pink and fluid.

C. Frustration level: Even though the subject is “focused” on the page he is not interpreting the information properly. A very slow with motion and a dull, brick red color is seen.

Once the patient’s response has been determined at various demand levels, the responses can be judged appropriate or deficient. The procedure can be repeated with appropriate plus lenses in order to ascertain the effect of these probe lenses.

Summary

A number of techniques for using a retinoscope have been described. Each method is associated with a different optometric pioneer whose insight helped to bring the use of the retinoscope to the fore. It is important to note that there is no one right way to use a retinoscope and that none of these techniques should be thought to be necessarily better or worse than another. Each technique seems to lend itself to answer different questions about the patient’s potential and actual behaviors. Thus, it is advised that optometrists familiarize themselves with a variety of these techniques. Practice each technique with a number of patients and become facile in using the technique so that it is available when needed.

The various techniques help ascertain the visual status at near and can help in both near and distance prescribing, or to learn about the patient’s mental/cognitive state. If the streak retinoscope is used, it should be used in the plano mirror mode to standardize the amount of light and the uniformity of the reflex. The spot contains only a plano mirror mode and is therefore not subject to these variations. Many of these procedures measure the lag of accommodation under varying circumstances and modify the prescription given either at distance or at near. It is important to pay careful attention to the differences (not just the similarities) between these various tests to understand what each evaluates, as well as why and when it should be used. Some clinicians may want to know the maximum possible relaxation of accommodation while others may want to determine the size or range of the lag of accommodation. Others may be more interested in when the system goes into stress or if the patient is attending/understanding the visual material. Interestingly, while some optometrists feel that expertise and interest in these techniques has waned, there seems to be increasing inter-

est among ophthalmologists of dynamic retinoscopy.^{35,36}

In the final analysis, this review can serve as a guide to both new and experienced practitioners in deciding the best retinoscopy technique for a clinical situation and how to use each depending on the patient or situation. Asking the right questions, will help find and understand the answers you receive.

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Source

a. OEP Foundation, 1921 E. Carnegie Ave., 3-L, Santa Ana, CA 92705, 949-250-8070, www.oepf.org.

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