VIEWPOINTS: Nearpoint Lens Prescribing

Determining the lens prescription that will foster optimal comfort and visual efficiency has long been a major aspect of optometric care. Various approaches have been developed to guide the clinician in the determination of the optimal lens prescription for near use, as well as for use in distance vision tasks. Lenses have been prescribed to prevent vision disorders and to permit normal vision development, as well as to promote comfort and visual efficiency. The determination and prescription of nearpoint lenses that permit optimal function is unique to behavioral optometry and has important implications for public health.

In this Viewpoints feature, two authorities on lens prescribing present their views. Dr. David Goss, Professor of Optometry at Indiana University School of Optometry, presents a rationale for nearpoint lens prescribing based on analysis of phorometric measures. Dr. Richard Apell, former Head of the Visual Department at the Gesell Institute of Human Development, presents an approach to lens prescribing that is based on performance rather than phorometric and refractive measures. In this editor's view, these complementary approaches provide the optometric clinician with an excellent overview of methods of prescribing lenses, and a useful armamentarium for clinical application.

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Determining the Optimal Nearpoint Plus Prescription Based on Case Types and Examination Test Results

DAVID A. GOSS, O.D., Ph.D.

Abstract

The prescription of nearpoint plus lenses when indicated for accommodation and vergence disorders can help to relieve asthenopia and improve reading performance. A systematic analysis of the results of comprehensive testing of accommodation and vergence is important in arriving at an appropriate diagnosis and treatment regimen. The case types in which patients benefit the most from nearpoint plus are convergence excess, pseudo convergence insufficiency, and accommodative insufficiency. Test outcomes used in the recognition of these case types are discussed, as well as methods for the derivation of the optimal nearpoint plus power.

Key Words

accommodation, convergence, lens prescriptions, optometric analysis

I am pleased to have this opportunity to discuss the prescription of nearpoint plus lenses for nonpresbyopes. Such prescriptions can be important in maximizing learning potential for children and for optimizing occupational efficiency in adults. It is important for us as clinicians to have a systematic approach to the analysis of accommodation and vergence disorders.

My approach involves a comprehensive assessment of convergence and accommodation. Testing for vergence disorders includes dissociated phorias, fusional vergence ranges, relative accommodation, nearpoint of convergence, and fixation disparity or associated phorias.[1,2] For vergence disorders, case types can be identified and treatment appropriate to the case type can be provided. The vergence disorder case types which respond well to nearpoint plus are convergence excess and pseudo convergence insufficiency.[3] Pseudo convergence insufficiency is actually an accommodative deficiency which results in a high exophoria at near.

Accommodative dysfunction can be examined by performing tests assessing (1) amplitude of accommodation, (2) accommodative facility, (3) lag of accommodation, and (4) relative accommodation.[2,4-7] Nearpoint plus lenses may be indicated when the amplitude of accommodation is low for the patient's age, when the lag of accommodation is high, and/or when the positive relative accommodation is low.[3] In other words, the patient has difficulty stimulating accommodation. This is sometimes referred to as accommodative insufficiency.[8-11] Guidelines for the diagnosis of case types indicating nearpoint plus and for the determination of amount of plus power follow.

Continued on page 10

PERFORMANCE TEST BATTERY: A Very Useful Tool for Prescribing Lenses

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Abstract

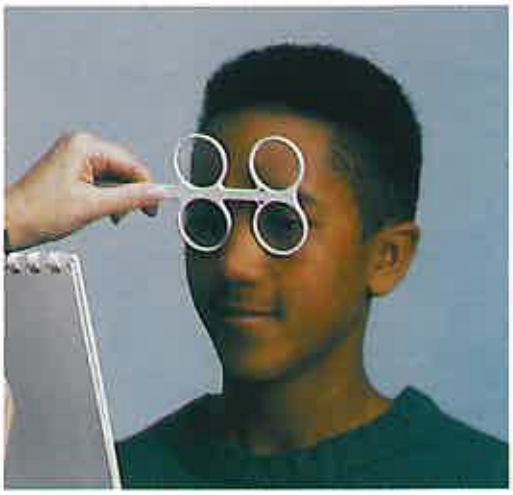
Performance tests are visual tests done outside of instruments, in which probe lenses are used to determine the lens prescription that permits the best visual performance. This paper presents a battery of such visual performance tests and a series of guidelines for lens prescribing in various refractive conditions based on the performance tests. The author argues that determination of the lens to be prescribed should be based upon visual performance rather than refractive measures.

Key Words

visual performance, lens prescribing

For more than 70 years, optometry has been aware of the need to prescribe lenses for nearpoint use, even in prepresbyopes, and especially for children. For some optometrists, this is a paradox. Why should a child who measures emmetropia, and has an adequate amplitude of accommodation, require lenses?

Often the parents of children with functional vision disorders have been told that their youngster has perfect eyes but is lazy and needs to try harder and learn how to concentrate. For many such children, appropriate lenses have a major impact. For example, a Dr. Getman brought his young son, Gerry, to a Skeffington meeting, and asked Dr. Skeffington to look at his son, who had been struggling with his studies. Before the audience, Dr. Skeffington examined Gerald and exclaimed, "This boy needs plus"! This was in the 1920s. And we all know how Gerry Getman went on to become a high achiever.



Skeffington,[1] through the Optometric Extension Program, went on to develop the 21-Point Examination. This was followed quickly by case typing, laws of lens application, and rules for analyzing deterioration of B type cases and syndromes of embeddedness. The goal was to prescribe lenses that were acceptable, that would not have to be made over because of patient rejection. For the first time, there was a method for prescribing lenses other than to compensate for refractive conditions. Now there was a systematic basis for prescribing lenses to replace the "seat of the pants" approach. This opened the door to the novel idea of prescribing lenses (plus) preventively. By the mid '50s, plus lenses for near were being over-prescribed, with the comment that if they didn't help, at least they wouldn't hurt.

When John Streff joined the Gesell Institute staff in the early '60s he was instrumental in developing a battery of visual performance tests. Why? The idea of an acceptable lens irked us. Acceptable did not necessarily imply useful. We wanted to involve the patient more in the examination process. As in visual therapy, we wanted greater freedom from spatial restrictions of instrumentation such as phoropters and stereoscopes. We wanted to test the patient in a more natural situation, including a lighted environment. Hence, the development and use of a visual performance test battery.

What is meant by visual performance tests? These are visual tests done outside of instruments, where probe lenses (low plus, cylinders, prisms, etc.) may be used to assess their effect upon performance. Dr. Streff insisted that near visual acuity be measured at a precise distance, and that visual acuity range tests be implemented at near test distances. The patient was given the card to hold where the letters were the clearest and most comfortable to read. Using a block of nearpoint 20/25 to 20/30 letters, the closest and farthest distance of readability were recorded.

Streff modified and developed the Bell retinoscopy procedure. My contribution

was to study the changes in Book retinoscopy when probe lenses were used. We wanted to find the *most usable lens* for near. We used the analytical examination to confirm or modify what we would prescribe. How we used and did the analytical tests also changed. By the time the performance tests were completed, we generally knew which lenses we would prescribe for near, if any.

Our battery of performance tests included the following:

1. Visual acuity at distance
2. Visual acuity at near (16")
3. Visual acuity range at near—closest, farthest, best, most comfortable
4. Cover test far and near
5. Nearpoint of convergence, break and recovery
6. Pursuit eye movements
7. Saccadic eye movements
8. Stereofly (gross stereopsis)
9. Titmus stereotest (fine stereopsis)
10. Bell retinoscopy
11. Book retinoscopy
12. Ball catch and throw

Visual acuity tests are performed unaided, with the patient's own lenses and with probe lenses. Performance on each of the above tests may be probed or evaluated with a variety of lenses, prisms, red glass, etc. The optometrist is free to add other tests to the battery. For example, Dr. Streff has found a pointer and straw test to be useful.

As we worked with this battery, we found an interesting change in the way we prescribed lenses. We began to focus on the near prescription rather than distance and to think of minus adds for distance rather than plus adds for near when prescribing bifocals. This concept has helped our students to break away from the traditional method of prescribing what you measure. More attention was paid to the needs of the patient in his or her nearpoint environment than to the measurements at distance.

In prescribing lenses, whether for near or far, the behavioral optometrist should emphasize performance rather than refractive measures. One should never prescribe a lens because "that is the measure," but rather because it improves performance on some or all of the tests listed above. The optimal lens prescription at any distance is that which optimizes performance at that distance, not that which neutralizes a refractive deviation. Although in some instances the lens formula for optimal performance may be the same as that which is measured, it should not be prescribed because it is the "refractive correction," but rather because the optometrist has probed performance with a variety of lenses and determined which particular lens prescription is optimal.

Lenses that are prescribed on the basis of case analysis may be well-accepted but are not necessarily useful in permitting optimal performance. Performance tests are done with a variety of probe lenses so that the lens that gives the best performance can be determined.

Following is a series of indications for prescribing lenses for individuals with a variety of refractive conditions. Unless there are some positive indications for prescribing nearpoint lenses, the likelihood of success is reduced: even if nearpoint lenses are prescribed in such cases, they are unlikely to produce significant beneficial change in behavior or performance.

I. Emmetropia (Plano to +1.00 D)
   1. The patient presents with a variety of subjective complaints, especially when related to near visual activities.
   2. There is improved near visual acuity and/or increased readability range with nearpoint plus lenses (note: normal readability range is from 4" to 24").
   3. Book retinoscopy shows Plano to -0.25 D with plus lenses, whereas without plus it was +0.50 D or greater.
   4. Bell retinoscopy shows a normal lag of accommodation with plus lenses, but an excessive lag of accommodation without plus.
   5. There are improved pursuit and saccadic eye movement performances with plus lenses.
   6. There is improvement in gross and fine stereopsis with plus lenses.
   7. If catching a ball improves with plus, a single vision plus lens prescription is indicated.

II. Hyperopia (+1.25 or more)
   1. The plus lens power that should be prescribed is that which provides the best near visual acuity and the greatest range of near visual acuity.
   2. The optimal lens is that which produces a normal lag of accommodation on Bell retinoscopy or monocular estimate method (MEM).
   3. When there is anisometropia, provide more plus for the more hyperopic eye only when there are positive indications on performance tests, i.e., improved stereopsis, near visual acuity, eye movements, etc.
   4. Provide the least amount of p for distance that improves performance and gives at least 20/30 visual acuity OU.
   5. Provide an anisometropic prescription at distance only when there are positive indicators. Don't prescribe it simply because it was "measured."

III. Myopia
   1. Prescribe the least minus or the most plus that provides the greatest range in near visual acuity OU. The farthest range should be at least 20".
   2. Prescribe the lens that provides a normal accommodative lag on Bell retinoscopy.
   3. The Book retinoscopy measure should not be more than a quarter diopter of against motion on easy reading material with the desired nearpoint lens.
   4. The lens power derived from the above criteria should be tested with other performance tests.
   5. The lens power for distance shou[illegible] permit good visual acuity or, w some patients, the lens power that feels the best should be prescribed. Some individuals will report differences in feeling, while others report seeing differences. Back off from the lens power that makes the letters appear smaller.
   6. Consider using a trifocal or progressive lens when the required add is greater than 1.25 D.

IV. Astigmatism
   1. Perform Bell and/or Book retinoscopy with simple plus spheres; if the cylinder disappears, consider prescribing low plus spheres for near use.
   2. Probe near visual acuity and near visual acuity ranges with simple plus spheres and with plus and minus cylinders; prescribe the cylinders only if they expand the range of clear vision. Otherwise prescribe the plus sphere that maximizes nearpoint range of clarity.
   3. Probe with the other performance tests in much the same manr Prescribe cylinders only if they i[illegible] prove performance. Otherwise prescribe the plus lens that maxi-

mizes performance. If simple plus spheres move the performance skills in the right direction, a prescription of plus sphere for near and Plano for distance may be appropriate. If minus cylinders produce the most favorable changes, then a simple minus cylinder (example: Plano -0.50 x 180) would be appropriate.

4. Look for the plus cylinder form in both Bell and Book retinoscopy, and consider prescribing it for near use. Consider prescribing the minus cylinder form for distance and the plus cylinder form for near, while maintaining one Plano meridian in each lens prescription. For example, in against-the-rule astigmatism:
   D.V. -0.50 cx 90
   N.V. +0.50 cx 180
   In with-the-rule astigmatism:
   D.V. -0.50 cx 180
   N.V. +0.50 cx 90
   As in previous examples, the lens prescribed should be that which gives the best performance.
5. Where feasible, try to maintain one Plano meridian (i.e., Plano -0.50 cx 180, or Plano +0.50 cx 90); try to keep the amount of cylinder prescribed equal for the two eyes; and try to keep the cylinder axes at 90/180. If this is not feasible, try to keep the cylinder axes symmetrical (i.e., axes 05 and 175, or axes 10 and 170). These guidelines may be followed as long as they do not produce impairment on the probes of visual performance.
6. Avoid giving a plus sphere component at distance.
7. Against-the-rule astigmatism may be a precursor of myopia development. Failure to prescribe a lens that optimizes performance at near, or prescription of distance correction only, may result in the individual's moving towards myopia.
8. When these guidelines are followed, one may expect improvement in visual acuity and other performance tests WITHOUT LENSES at the next visit.

V. Anisometropia in which one eye is emmetropic and the other myopic

1. This condition develops primarily in school-age children. Visual acuity is normal at distance with the emmetropic eye, and normal at near with the myopic eye. Gross and fine stereopsis may be reduced and/or demonstrate slow responses. Pursuit and saccadic eye movements are variable. If this condition is left untreated it may lead to the development of esotropia, or development of myopia in the previously emmetropic eye, so that both eyes increase in myopia with maintenance of anisometropia.
2. Expect the child to argue against any prescription since he or she can see clearly both at distance and at near without any glasses.
3. Prescribe lenses to achieve a balance between the two eyes at both distance and near, especially at near.
   a. Bell and Book retinoscopy typically show marked with motion in the emmetropic eye. Probe with plus lenses before the emmetropic eye until balance is achieved. Use the unfused cross cylinder test to confirm the results of Book and Bell retinoscopy.
   b. Determine the plus lens before the emmetropic eye that will balance the monocular near acuity ranges.
   c. Determine the appropriate minus lens for the myopic eye to provide best acuity for distance.
   d. Prescribe minus for the myopic eye and Plano for the emmetropic eye in order to achieve balance at distance, with a plus lens addition that maintains balance and brings the myopic eye to Plano at near.
   e. Over time, one may expect reduction in myopia and improved visual acuity in the myopic eye. The emmetropic eye will frequently require less plus at near.

VI. Presbyopia

1. Use the battery of performance tests along with phoropter tests to determine the most suitable prescription for near. The most appropriate lens for near is one which increases the near acuity range in both directions.
2. For emmetropic and low hyperopic presbyopes who have not worn lenses at distance, experience no eyestrain when driving or watching television, and have distance visual acuity of solid 20/30 or better, prescribe Plano at distance with the indicated add. The danger of prescribing low plus for distance when the patient measures low hyperopia is that it may eventually lead to "progressive presbyopic hyperopia," in which the patient requires increasing plus for distance to produce 20/20 or best acuity. Low hyperopic lens correction should thus not be prescribed for distance unless the patient requires a prescription to resolve complaints of asthenopia or distance vision blur. For the same reason, one should avoid use of single vision reading glasses initially, as the patient will frequently look out at distance through the reading prescription and may begin to manifest increased hyperopia, with increased need for plus lens correction for distance vision.
4. For the myopic presbyope, as for the emmetrope or hyperope, prescribe the nearpoint add that provides the best performance and acuity range. The myope who habitually removes his or her glasses for close work may be resistant to using the optimal lens for near, preferring to just remove his or her distance correction. In such cases, the acuity range tests should be helpful in demonstrating the usefulness of a nearpoint prescription.
5. Even in cases in which a nearpoint prescription of Plano is optimal for the presbyopic myope, one should prescribe a bifocal with an add to bring the near prescription to Plano, rather than simply counseling the patient to remove his/her distance glasses for near. If one prescribes distance glasses with instructions to remove the glasses for near, the patient will frequently fail to remove the glasses for many tasks within arm's length, with consequent strain and difficulty.
6. In presbyopic myopes, one may expect some increase in myopia and/or anisometropia if the optimal lens for near is not prescribed and properly used.

Summary

The use of performance tests places greater emphasis on the patient's judgments and reactions at all distances. The patient is more involved in the examination process. It is far more than "better or

worse," "clear or blurred," "double or single." The optometrist becomes more involved in the process and is not likely to say, "I prescribed it because that is what I measured." Rather, the optometrist seeks to determine and prescribe that lens which provides the best performance. Visual hygiene, a part of lens prescribing, will be discussed in a future article.

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Continued from page 6

Convergence Excess

In convergence excess the distance phoria is normal and the near phoria shows eso.[1,12,13] Thus the ACA ratio is high. The positive relative accommodation (PRA) finding is usually low. The base-in fusional vergence range at near is often low. A useful way of assessing the consistency of findings and confirming the diagnosis of convergence excess is to observe the zone of clear single binocular vision (ZCSBV). The left and right sides of the ZCSBV and the phoria line will all tilt to the right more than the demand line.[1,12] The power of the add can be determined by finding the amount of plus which shifts the near phoria to ortho or low exo.[3,12] Take, for example, a patient with orthophoria at distance and 5Δ esophoria at near with correction, and 1Δ exophoria at near with a +1.00 D add. The calculated ACA ratio is 8Δ /D. The gradient ACA ratio is 6Δ /D. The +1.00 D add is enough to shift the near phoria into exo. Use of the gradient ACA ratio suggests that a +0.75 D add would not be enough: (+0.75 D) x 6Δ /D) = 4.5Δ , which would not shift the 5Δ esophoria into exo.

If the patient does not give reliable responses on phoria testing, alternative methods for deriving the add power are (1) finding the plus add which reduces the near eso fixation disparity to zero, using a target such as a Mallett unit, Borish card, or Wesson fixation disparity card,[14-18] or (2) finding the plus add which balances the negative relative accommodation (NRA) and the PRA.[19]

It is advisable to show the patient the proposed add in a trial frame. This serves two functions. First, it confirms testing results. The convergence excess patient will usually notice that letters become larger, clearer, and more comfortable to read with the plus add. Secondly, it demonstrates to patients that their optimum lens correction for near is not necessarily the same as their distance correction. Once this has been demonstrated, then the options of bifocals, progressive addition lenses, or single vision reading glasses can be discussed.

Pseudo Convergence Insufficiency

In pseudo convergence insufficiency a high lag of accommodation results in a high exophoria at near.[3,20] Like convergence insufficiency the distance phoria is normal, the near phoria is a high exo, and the nearpoint of convergence (NPC) is receded. It differs from convergence insufficiency in that there is a high lag of accommodation at near, which can be observed with dynamic retinoscopy.

An interesting phenomenon in pseudo convergence insufficiency is that typically the NPC improves when the patient views through a plus add. It is not clear why this occurs. Perhaps the plus add improves the accuracy of the accommodative response so that accommodation and accommodative convergence can increase as the target is moved closer to the patient. The appearance of the ZCSBV is helpful in confirming the diagnosis of pseudo convergence insufficiency. The phoria line is tilted to the right less than the left and right sides of the ZCSBV.[3,12,21] That is, the phoria line suggests a low ACA ratio as in convergence insufficiency, but the tilt of the left and right sides of the ZCSBV suggest a normal ACA ratio.

Pseudo convergence insufficiency is treated as an accommodative insufficiency. A plus add is prescribed based on the accommodation findings. Determination of add power in accommodative insufficiency will be discussed below.

Measurement of Lag of Accommodation by Dynamic Retinoscopy

The lag of accommodation can be measured clinically by dynamic retinoscopy using the monocular estimate method (MEM) or the Nott method. Most optometrists are familiar with MEM dynamic retinoscopy. The lag of accommodation is estimated by judging the width, speed, and brightness of the retinoscopic reflex.[5,9,22-25] I have found the Nott method[5,26,27] to be another useful method of measuring the lag. For the Nott method, the test card is usually suspended from the phoropter reading rod because the examiner moves the retinoscope independently of the test card. If a with motion is observed with the retinoscope in the same plane as the test card, the examiner moves the retinoscope farther away from the patient until neutral is observed, leaving the test card in its original plane. The distance of the retinoscope from the spectacle plane is converted into the dioptric accommodative response. The lag of accommodation is found by subtracting the accommodative response from the accommodative stimulus. For example, if neutral is noted when the retinoscope is 50 cm from the spectacle plane and the test card is 40 cm from the spectacle plane, the lag is 0.50 D:

accommodative stimulus =
1/0.4 m = 2.50 D
accommodative response =
1/0.5 m = 2.00 D
lag of accommodation =
2.50 D - 2.00 D = 0.50 D

Rouse et al.[28] found the mean lag of accommodation in school children using MEM to be 0.33 D (SD = 0.35) for right eyes and 0.35 D (SD = 0.34) for left eyes. Jackson and Goss[29] found the mean MEM for a 40 cm test distance in another sample of school children to be 0.23 D (SD = 0.29). The values obtained with the Nott method are very similar to those found with MEM.[29,30] With either technique, most non-presbyopes have lags in the range of 0 to 0.75 D.

Accommodative Insufficiency

In accommodative insufficiency the patient has difficulty increasing accommodation, as evidenced by a high lag of accommodation, a low amplitude of accommodation, a low PRA, and/or difficulty clearing the minus side of the lens flippers for accommodative facility testing. A useful way of determining the power of the plus add is to subtract 0.25 D from the lag of accommodation as measured by MEM or Nott retinoscopy. Confidence in this add power is improved if it also approximately balances the NRA and PRA, and if the patient's subjective response to it is positive during demonstration of the lens power in a trial frame. The patient should report improved clarity and/or comfort when looking at print in a book or magazine.

Comments

Among the tools available to the clinician to improve clarity, comfort, and efficiency of vision is the use of plus adds in the form of bifocals or single vision nearpoint lenses. The patients who benefit the most are those who can be identified as having convergence excess, pseudo convergence insufficiency, or accommodative insufficiency. The references cited herein can be consulted for further information.

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