



New York State Society of Opticians, Inc.

48 Howard Street

Albany, NY 12207

518/426-0599/Fax: 518/463-8656

E-Mail: nysso@caphill.com

Web Site: www.nysso.org

New York State Continuing Education Mail-In Course

Basic Refraction Procedures

by Warren G. McDonald, Ph.D.

NYS CEC Code #98-71

Refraction is defined as "the act of determining the focal condition (emmetropia or various ametropias) of the eye and its corrections by optical devices, usually spectacles or contact lenses" (Keeney, et al., 1995, p. 254). Many opticians around the country, and particularly in New York, have shown great interest in learning the procedures involved but have been unable to take a course on the subject. This article is designed to introduce the subject to those interested, and to provide some continuing education for former refraction students. At the end of the article is a multiple-choice test which will allow readers to test themselves on the subject matter.

One caveat: reading this material will not make you a refractionist! There is a great deal of material to cover on refraction, and this course is only an introduction to merely help you get started, or revisit previously learned material. If you are interested in further materials, there are a number of courses taught at the opticianry schools throughout New York that provide a broad base of knowledge on the subject matter, and the Opticians Association of America (OAA) offers a very fine program at various sites around the country, taught in a weekend format. There are also private courses that can provide similar material. Something very exciting is also available through the OAA -- a distance learning course on the theory of refraction. All of these offerings are creditable, and can greatly assist the reader in learning refraction.

Ocular Anatomy

While it is understood that most of you are well grounded in anatomy and physiology, a bit of review would be beneficial.

Light comes through the refractive media and comes to focus somewhere near the retina. There are four parts of the system that focuses light. They are:

1. the cornea
2. aqueous
3. the lens
4. vitreous

Any abnormality in any one of the refractive media can cause a blurred retinal image. Students often argue that the retina is a part of the refractive media, but I want you to think of it right now as the film in a human camera. It is the job of the refractionist to determine whether or not a blurred image is a refractive problem, or medical condition which should be referred to

This course is worth one (1) New York State Continuing Education Credit, which can be applied to your Ophthalmic Dispensing or Contact Lens licensing requirements.

a medical practitioner.

History

Before beginning any refraction, it is important to do a thorough history on the patient/client. A history should include:

1. chief complaint
2. age
3. ocular history, including last exam
4. medications
5. medical history
6. family medical history
7. allergies
8. current Rx (if any)

A great deal of information is derived from the history. Care must be taken to record information derived from

the patient/client exactly as presented to you. Do not try to “dress up” the information with more technical terms, but chart it exactly as presented. They sometimes may not be saying what you think they are.

If, on completion of the history, you feel this person is not a candidate for a refraction alone, but needs a complete exam, it is incumbent on you to refer him or her to an appropriate provider. Opticians are not eye doctors, and the eye health of the patient must always remain the paramount concern. For example, if a patient presents a complaint of itching and burning, he or she must be referred out. If a refraction is necessary, it can be done after the medical condition is quiet.

Pre-Tests

There are a number of pre-tests that can tell us a great deal. Included are:

1. pupil measurement
2. visual acuity with and without current Rx
3. pupillary reflexes
4. ocular motility tests (broad H test, etc.)
5. near point of convergence
6. amplitude of accommodation
7. range of accommodation
8. cover tests
9. stereopsis
10. color vision screening
11. observation of the external adnexa
12. pin-hole acuity

I will not go into specific detail about these procedures, but I do want to call your attention to the pin-hole acuity test. As mentioned earlier, it is imperative to recognize when to refer. The pin-hole acuity test will clearly indicate whether or not a refractive condition is present, or if the blurred image is caused by something else. As you recall from basic optics, central light rays come to focus at a different place than peripheral rays. Placing a pin-hole before the eye will cause a substantial improvement in visual acuity in someone with a moderate or greater refractive error. If a pin-hole shows no improvement, the error may not be refractive and needs to be referred.

Subjective Procedures

There are many ways to find the refractive status of the eye. In the old days of refraction, everything was done totally on the subjective response of the patient. Today, we still depend a great deal on those subjective responses to help us arrive at the perfect neutralization.

A refraction can be accomplished using entirely subjective means. Using a guide called Eggers Chart logic, one can gauge the rough amount of ametropia present, if any. Eggers Chart is a numerical chart using the premise that each line away from emmetropia on the Snellen Chart represents approximately .25-.50 diopters of ametropia. For someone who reads 20/40 on the Snellen Chart will have a rough ametropia of approximately .75 diopters. Eggers Chart logic does not tell us what ametropia, merely how much. From that information we can readily judge whether the subject is a myope or hyperope by utilizing test lenses (NYRO, 1995).

The world would be a wonderful place if that were all there was to it, but something called astigmatism is around to mess up our day.

Astigmatism can be detected by using a couple of subjective techniques. The first we will talk about is the “clock dial.” This technique uses a plus lens to “fog” the patient to approximately 20/40. A dial that looks like the hands on a clock is placed at 20 feet, and the patient is to report if one set of hands on the clock looks clearer. If all the hands on the clock are equal, no astigmatism exists; if one set of hands is clearer or sharper, then there is astigmatism present. The axis can be determined by multiplying the lower numbered hand on the clock by thirty. For example, if the patient reports the 2 and 8 o'clock positions to be clearest, then the axis would be 60 degrees.

We can also find astigmatism subjectively by utilizing the Jackson Crossed Cylinder on the phoropter. The JCC is a lens with a spherical equivalent of plano used for a number of tests. It features a set of red dots, meaning minus power, and a set of white dots, plus power. The usual JCC has a +0.25 and a -0.25, but it may be +/-0.50. By placing one of those sets of dots on the principal meridians, you can find the presence of astigmatism. It is difficult to adequately describe here; you need to see it and touch it to understand it, but for now, I want you to know it will work.

Once a rough idea of what the refractive error is determined, we must refine, or “fine tune,” our findings. To do that, we again utilize the JCC, but this time at a 45-degree angle to the axis. By simply bracketing around the axis, we can refine the cylinder power. You cannot find the correct power without first finding the axis. This refinement is again accomplished by placing the dots on the JCC on top of the axis. This refinement is again accomplished by placing the dots on the JCC on top of the axis. By asking which looks better -- red or white dots -- we can easily find the right cylinder power. Again this is extremely difficult to get across in this fashion, but, if you have a phoropter at your disposal, you should take a look at it to gain a better understanding.

There is still one more thing we have to do before proceeding on to the other eye; we must make certain we are not over-misused; to give too much minus power can cause a problem with accommodation and convergence. We have a couple of different ways to monocular balance. The first is the red-green or duochrome test. As you know, the red component in white light comes to focus at a different place than green. By showing the patient a 20/40 line and a colored slide with half the letter in green and half in red, we can determine if we are balanced. If the patient reports the letters in red blacker, sharper, or darker, too much plus has been employed. A favor of green means we have provided too much minus power. The second monocular balancing technique employs a three-click blue. We earlier presented Eggers Chart and described a 20/40 test line being approximately 0.75 diopters away from emmetropia. The same idea is employed here. If we dial in three “clicks” of plus power (each small

movement of the large sphere wheel on the phoropter is 0.25) then the 20/40 line should be blurry. If it takes six clicks, then we have too much minus power. Go back three clicks, and you should be at the optimum monocular refraction. Remember, when doing a refraction it is best to leave the patient at the maximum plus. MPMVA means Maximum Plus for Maximum Visual Acuity. That is a good acronym to remember.

Once we have completed the balancing procedures on the right eye, the same steps must be done for the left. When they are accomplished, one final step remains: binocular balancing. This is simply accomplished by splitting the two images with a dissociating prism (Borish, Vol. 2, 1970, p. 753). There is a 6 diopter prism on the phoropter that will move the right image down. By looking at the two images simultaneously, the patient is asked if both images are equal, or if one is better than the other. If one is better, we add +0.25 to that better image and ask again. Usually this will correct the balance and the basic refraction is complete. An additional step some refractionists do is to complete a binocular 3-click blur, just to be certain we are at MPMVA.

Objective Procedures

We can also perform refraction using a variety of objective tests. Today, many offices utilize an autorefractor, which can provide a fairly accurate estimation of the refractive error. While an autorefractor is a great machine, we will focus our attention to a much simpler device: the streak retinoscope. The streak retinoscope is a device invented by Jack Copeland around 1920 (Corboy, 1989). While others had defined streak retinoscopy, Copeland's scope is the basis for all others today.

In streak retinoscopy, the refractionist sweeps across the pupil with the scope, watching the movement of the streak of light from the scope in the eye. If the streak appears to be moving against the direction the scope is moving, minus lenses are employed. If the streak moves with the observer, plus is required. If there is no apparent motion, neutrality has been reached. The streak will vary in different meridians if astigmatism is present. This procedure sounds simple here, and it basically is, but it is difficult to master. It takes time and practice to become proficient. It is also important to remember that when one is scoping, the eye is "chained" to the scope. The refractionist is only about 67 centimeters away from the eye. An extra -1.50 diopters must be added to the retinoscopy finding to move the focal plane to infinity, or the retinoscopy lens on the phoropter may be employed. Again, this topic is difficult to present, and must be seen and done to fully understand.

Once the objective procedure is completed, the subjective refinement procedures described earlier are employed.

The significance of objective procedures is evident with illiterate patients, children, or others who can't subjectively respond. It is also much faster than a strictly subjective procedure.

Reading Adds

To find the correct reading add is a difficult task. Most refraction errors come from improper add power. We will not attempt to discuss a great deal of theory here, but you should know that a patient can comfortably utilize 1/2 of their available amplitude of accommodation (the amplitude of accommodation is the reciprocal of the near point). Amplitude diminishes with age. For example, researchers claim we have, at age 10, between 11 and 14 diopters of accommodative amplitude; at age 40, it is between 4.5 and 5.5 (Borish, Vol. 1, 1970, pp. 169-170). It takes +2.50 diopters of accommodation to focus at 16 inches, which is the normal reading distance. If we only have approximately +5.00 available, then it is easy to see why we need bifocals around age 40. Unfortunately, all people are not the same. Some need a +1.00 add at 40, while others prefer a +1.25.

A fairly simple, but effective, way to determine add power is to utilize an Eggers Chart for near. A rule of thumb that works well states that at age 40, a +1.00-+1.25 add will be required. Add +0.25 for every 5 years of age. For example, if at age 40 a +1.00 add is required, a +1.25 would be expected at age 45.

Always test subjectively. Ask patients about their reading requirements. Some like to read at 20 inches, others at 14. Computer use should be discussed, and an approximation of the computer screen distance should be formulated. Using the near point rod on the phoropter it is relatively simple to check the range through the reading add. Some compromises may need to be made, or specialty glasses for computer use required. Communication is extremely important in refraction. Discussing the patient's needs and expectations is the most important thing the beginning refractionist must learn.

Additional Testing Procedures

There are a multitude of functional tests that would be performed at the end of the basic refraction that are beyond the scope of this article. Tests for phorias and tropias may be the topic of the next article on refraction.

Conclusion

Refraction is an exciting adjunct to opticianry. As you can see, it is something that you can easily do with the proper training. There are job opportunities available for opticians trained in refraction, or ophthalmic opticians as they are known in Europe. I encourage you to take a course in refraction if you have not; and if you have, keep up to date with continuing education seminars. For those interested, NYSSO has a video and a manual available that further addresses refraction. I encourage you to get involved, even if you don't want to refract. I guarantee you will learn a great deal!

References:

Borish, Irvin M. (1970). CLINICAL REFRACTION (3rd Edition). Professional Press, New York.

Basic Refraction Procedures Mail-In Test

(NYS CEC Code #98-71)

Circle the best answer for each question and return to:
NYSSO, 48 Howard Street, Albany, NY 12207 • fax (518) 463-8656

Name: _____ License # _____

Mailing Address: _____

NYSSO Member: Yes No **If no, the registration fee is \$30.00; please complete the Method of Payment section below or the membership application provided:**

Method of Payment: Check (payable to NYSSO) Credit Card (please complete section below)

Type of Credit Card: Visa Mastercard Dollar Amount: _____

Expiration Date: _____ Card #: _____ Signature: _____

- | | | |
|--|---|---|
| <p>1. Refraction is the act of determining the:
a. focal condition of the eye
b. eye color
c. contact lens Rx
d. none of the above</p> <p>2. Which is not a refractive component of the human eye?
a. cornea
b. retina
c. lens
d. vitreous</p> <p>3. A history should include all except:
a. near point of accommodation
b. chief complaint
c. age
d. medications</p> <p>4. Pre-tests include all except:
a. p.d.
b. medical history
c. visual acuity
d. all the above</p> <p>5. A good way to tell if blurred vision is refractive or medical in nature is:
a. cover test
b. stereopsis
c. external adnexa
d. pin hole acuity</p> <p>6. Egger's Chart logic says that for every line away from emmetropia, there exists an ametropia of approximately:
a. 2D
b. 0.25-0.50D
c. 1D
d. 0.75D</p> <p>7. Astigmatism can be found subjectively using:
a. sphere dial
b. clock dial
c. 20/40
d. can't be found subjectively</p> | <p>8. The Jackson Crossed Cylinder has a spherical equivalent of:
a. +0.25
b. -0.25
c. plano
d. not possible</p> <p>9. The JCC can be used for all except:
a. finding the presence of astigmatism
b. axis refinement
c. power refinement
d. balancing</p> <p>10. Monocular balancing is accomplished by:
a. red-green test
b. 3 click blur
c. both a & B
d. none of the above</p> <p>11. The eye should be left at the maximum plus to be certain:
a. accommodation is not stimulated
b. convergence is not affected
c. both a & b
d. neither a nor b</p> <p>12. Binocular balancing is accomplished by:
a. prism dissociation
b. red-green test
c. cover/uncover
d. pupillary reflex</p> <p>13. The most widely utilized instrument used for objective refraction in the:
a. phoropter
b. clock dial
c. streak retinoscope
d. autorefractor</p> <p>14. The procedure used in the case of patients unable to respond to subjective questions is:
a. subjective refraction
b. objective refraction
c. autorefractor
d. unable to refract</p> | <p>15. At the end of retinoscopy, the findings must be adjusted to place the focal plane at optical infinity. How much must we adjust the findings?
a. 4D
b. 3D
c. -1.50D
d. +1D</p> <p>16. At age 40 we would expect to have about diopters of accommodation.
a. 2D
b. 5D
c. 3D
d. 10D</p> <p>17. As we age our amplitude of accommodation:
a. increases
b. decreases
c. stays static
d. levels off</p> <p>18. One of the most important things for the beginning refractionist to learn is:
a. sales
b. subjective technique
c. objective technique
d. communication skills</p> <p>19. The first bifocal prescribed, according to the rule of thumb mentioned, would be:
a. 1-1.25
b. 0.75
c. 2
d. 1.50</p> <p>20. What is the name for refracting opticians in Europe?
a. Ophthalmic Opticians
b. Refractionists
c. Contact Lens Specialists
d. Licensed Opticians</p> |
|--|---|---|

Membership Application

INDIVIDUAL'S NAME _____ COMPANY _____

HOME ADDRESS _____ FAX # _____

BUSINESS ADDRESS _____ EMAIL ADDRESS _____

PHONE (HOME) _____ PHONE (BUSINESS) _____

Preferred Address: Home Business Preferred Phone: Home Business

Membership Type: Active (\$150) Newly Licensed Active (\$75) Associate (\$75) Student (\$10)
(see below for category descriptions) Retail Corporate (\$150) Associate Corporate (\$150)

Method of Payment: Check (payable to NYSSO) Credit Card (please complete section below)

Type of Credit Card: Visa Mastercard Dollar Amount: _____

Expiration Date: _____ Card #: _____ Signature: _____

Membership Year is September 1-August 31.

(Membership fees with applications received after March 1 will be pro-rated at 50%)

Mail Application to: NYSSO, 48 Howard Street, Albany, NY 12207.

NYSSO Membership Services Line: (518) 426-0599 • NYSSO Membership Services Fax Line (518) 463-8656

To be listed accurately in the NYSSO Membership Directory, please indicate which of the following services are offered by your business:

- Artificial Eyes Contact Lenses
 Eyeglasses Refractions Available
 Hearing Aids Low Vision

Please Complete the Following:

Chapter (see map) _____ Date of Birth: ___/___/___

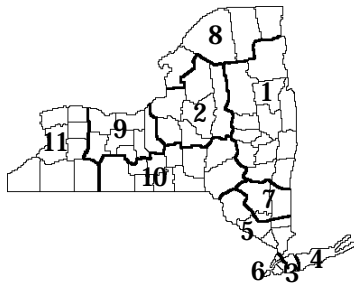
NYS License # _____ Sex: Male Female

Contact Lens Fitter # _____ Signature _____

Sponsor (if applicable): _____ Date _____

Please indicate to which organizations you belong:

- American Board of Opticianry Certified (ABO)
 Fellow, National Academy of Opticianry (FNAO)
 Opticians Association of America (OAA)
 National Contact Lens Examiners (NCLC)
 Contact Lens Society of America (CLSA)



NYSSO Chapters

- | | |
|------------------------|----------------------|
| 1. Capital District | 7. Mid Hudson Valley |
| 2. Central | 8. North Country |
| 3. Long Island-Nassau | 9. Rochester |
| 4. Long Island-Suffolk | 10. Southern Tier |
| 5. Lower Hudson Valley | 11. Western |
| 6. Metropolitan | Out of State |

Membership Categories

ACTIVE MEMBERSHIP— Annual dues of \$150.00. Any person possessing a valid New York State ophthalmic dispensing license is eligible to become an Active Member. Only Active Members are eligible for free Continuing Education credits at regional chapter meetings.

NEWLY LICENSED MEMBERSHIP — Annual dues of \$75.00 (first year), \$100.00 (second year), and \$150.00 (third year). Any newly licensed optician (licensed within the past six months) is eligible for the special three-year pro-rated membership incentive. Newly licensed opticians who join under the special offer will be entitled to full Active member benefits.

ASSOCIATE MEMBERSHIP— Annual dues of \$75.00. Any person not qualified for active membership, but engaged in opticianry, shall be eligible to become an Associate Member. Associate Members are entitled to all the rights of an Active Member, except voting and free NYS Continuing Education credits. They may participate in all activities of this Society, unless specifically excluded by the Board of Directors.

STUDENT MEMBERSHIP — Annual dues of \$10.00 while in an accredited program. Any person who is an enrolled student in a New York State-accredited

program for ophthalmic dispensing is eligible to become a Student Member. Student Members are entitled to all rights of an Active Member, except voting and free NYS Continuing Education credits. They may participate in all activities of this Society, unless specifically excluded by the Board of Directors.

RETAIL CORPORATE MEMBERSHIP — Annual dues of \$150.00. Any proprietorship or corporation maintaining 51% of its licensed opticians as members of this Society and upholding the By-Laws and Constitution of the Society is eligible to become a Retail Corporate Member. Retail Corporate Members are entitled to all rights of an Active Member, except voting and free NYS Continuing Education credits. They may participate in all activities of the Society, unless specifically excluded by the Board of Directors.

ASSOCIATE CORPORATE MEMBERSHIP — Annual dues of \$150.00. Any firm which does not qualify as a Retail Corporate Member, but which supports the objectives and purposes of this Society is eligible to become an Associate Corporate Member. Associate Corporate Members are entitled to all rights of an Active Member, except voting and free NYS Continuing Education credits. They may participate in all activities of this Society unless specifically excluded by the Board of Directors.