BASIC REFRACTION PROCEDURES
SUBJECTIVE TESTING

Subjective testing requires a response from the patient. There are many ways to find the refractive status of the eye.

Refraction can be accomplished using entirely subjective means. Using a “guide” called Egger’s Chart Logic, one can gauge the rough amount of ametropia present, if any. Egger’s Chart Logic uses the premise that each line away from emmetropia on the Snellen Chart represents approximately .25-.50 diopters of ametropia. Someone who reads 20/40 on the Snellen Chart will have a rough ametropia of approximately .75 diopters. Egger’s 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 trial lenses.

Egger’s Chart Logic will tell us a great deal about the refractive ametropia present. For every line away from emmetropia, the refractive error is approximately 0.25D on the lower end of the Snellen Chart, and 0.50 on the higher end of the chart.

Once the rough error is determined, we must determine whether there is astigmatism present. We can use the Jackson Crossed Cylinder in the phoropter, or as they did in the old days, a CLOCK DIAL. If there is astigmatism, then we must first find the axis.

Cylinder Axis

The axis is located first before anything else. You cannot find correct power if the axis is off! Jackson’s Crossed Cylinder is typically used today. It is a lens with a spherical equivalent of plane. For example, the red dots are typically -0.25, while the white dots are +0.25. The overall power is +0.25 -0.50. SE=Plano.

We can also find astigmatism subjectivity by utilizing the Jackson Crossed Cylinder (JCC) 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 meaning 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 describe it adequately 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 the dots are positioned at a 45-degree angle to the axis. By simply bracketing around the axis, we can find the exact axis location. You cannot find the correct power without first finding the axis.

2 Revised 8/2009
Sphere Refinement

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-minused; to give too much minus power can cause a problem with accommodation and convergence. Minus power will stimulate the accommodative reflex. There are a couple of different ways available to us to monocularly balance a patient. The first is the red-green or duo chrome test. The red component in white light comes to focus at a different place than the green component. By showing the patient a 20/40 line and a colored slide with half the letter in green and half the letter 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 the green means that we have provided too much minus power.

The second monocular balancing technique employs a three-click blue. We earlier presented the Egger’s 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 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, all of the same steps must be done for the left, from rough sphere to red-green. When they are accomplished, one final step remains - binocular balancing. This is simply accomplished by splitting the two images with a dissociating prism. 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.

Repeat the following steps for both eyes:
1. Axis
2. Cylinder Axis
3. Cylinder Power
4. Sphere Refinement
To make certain that the eyes are working as a system, make sure the prescription is balanced if possible. To do that several methods can be employed. Adding a +0.75 should cause the 20/40 line to become slightly blurred (remember Eggers’s Chart Logic?). If it takes over that then we have over-minused the patient. Also, a red-green or duo chrome test may be employed.

**Objective Procedures**

Objective procedures require no patient response. 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.

**Refractive Conditions**

Refractive or axial conditions are typically responsible for refractive error. The focal length or dioptic power formula mathematically describes the focal point, which is what we are measuring in refraction; how much power does it take to place the focal point at the retina?

It is difficult to find the correct reading adds. Most refraction errors come from improper add power. We will not attempt to discuss a great deal of theory there, but you should know that a patient can comfortably utilize ½ 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 between 11 and 14 diopters of accommodative amplitude at age 10; at age 40, it is between 4.5 and 5.5. 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, not all people are the same, some need a 1.00 add at 40, while others prefer a 1.25.

Every eye has a near point and a far point. We discussed earlier how to measure amplitude, and it is the same thing. The far point for a hyperope is beyond infinity, but for a myope, may be less than 20 ft. The same for near points; the myope may have a near point very close to the eye, while the hyperope is further away. That is why myopes typically do not need reading help as soon as hyperopes.

A fairly simple, but effective way to determine add power is to utilize an Egger’s 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 +12.00 add is required, a +1.25 would be expected at age 45.

Always test subjectively. Ask the patient about their reading requirements. Some like to read at 20 inches, others at 14 inches. 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.
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Retinoscopy

**Equipment:** Retinoscope

**Purpose:** The retinoscope is the primary diagnostic instrument. In the ophthalmic exam, we are seeking the broadest intercept possible. The instrument utilizes a sleeve to control width and focal point of the light beam. When performing retinoscopy, use the course beam of light. The scope can be focused, but we want the light to be parallel coming into the eye.

**Testing Process:**

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 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. The focal point measured at that point is on the scope. An extra -1.50 diopters must be added to the retinoscopy finding to move the focal plane into 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. It takes time and practice to become proficient.