National Academy of Opticianry

Continuing Education Course

Approved by the American Board of Opticianry and the National Contact Lens Examiners

Optical Dilemmas and Solutions

National Academy of Opticianry
8401 Corporate Drive #605
Landover, MD 20785
800-229-4828 phone
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National Academy of Opticianry

PREFACE:

This continuing education course was prepared under the auspices of the National Academy of Opticianry and is designed to be convenient, cost effective and practical for the Optician.

The skills and knowledge required to practice the profession of Opticianry will continue to change in the future as advances in technology are applied to the eye care specialty. Higher rates of obsolescence will result in an increased tempo of change as well as knowledge to meet these changes. The National Academy of Opticianry recognizes the need to provide a Continuing Education Program for all Opticians. This course has been developed as a part of the overall program to enable Opticians to develop and improve their technical knowledge and skills in their chosen profession.

The National Academy of Opticianry

INSTRUCTIONS:

Read and study the material. After you feel that you understand the material thoroughly take the test following the instructions given at the beginning of the test. Upon completion of the test, mail the answer sheet to the National Academy of Opticianry, 8401 Corporate Drive, Suite 605, Landover, Maryland 20785 or fax it to 301-577-3880. Be sure you complete the evaluation form on the answer sheet. Please allow two weeks for the grading and a reply.

CREDITS:

The American Board of Opticianry and the National Contact Lens Examiners have approved this course for two (2) Continuing Education Credit toward certification renewal. To earn this credit, you must achieve a grade of 80% or higher on the test. The Academy will notify all test takers of their score and mail the credit certificate to those who pass. You must mail the appropriate section of the credit certificate to the ABO and/or your state licensing board to renew your certification/licensure. One portion is to be retained for your records.

AUTHOR:

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COURSE LEVEL:

Technical / Advanced

COURSE DESCRIPTION:

This course explores the many facets of ethical decision-making in the optician's world. Special emphasis is placed upon the visual ramifications of poor ethical decisions. This impact on visual acuity is addressed through analysis and application of the Snellen system, ANSI standards, prismatic errors and vertex distance compensation. Real world case studies are also presented, reviewed and discussed in light of their ethical consequences as well as their visual and safety ramifications.

LEARNING OBJECTIVES

Upon completion of this course, you should be able to:

- Explain the difference between ethics and laws
- Explain the difference between how ethics and laws shape our behavior
- Describe the basis for optical minimum standards and tolerances
- Design an optical cross in order to analyze an ophthalmic prescription
- Explain how the Snellen visual acuity system is designed for visual assessment
- Describe the effect to vision from tinted lenses and automobile windshields
- Explain various origins for visual asthenopia
- Solve prismatic error problems
- Solve vertex distance compensation problems
- Define various refractive errors
- Evaluate how an uncompensated vertex distance prescription can affect vision
- Discuss ethical versus unethical opticianry behavior with respect to visual acuity
- Describe the communication skills necessary for avoiding ethical quandaries with optical professionals
- Describe how to take a visual acuity
- Describe how to record visual acuity
- Explain the role of ANSI

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Definition of Terms

ACUITY: (Visual Acuity) The ability of the human eye to distinguish between an object and its background; the resolving power of the human eye; an objective or subjective measurement of the eye's ability to decipher an object as compared to a standard. The Snellen chart is the most commonly utilized standard.

ANISOMETROPIA: The refractive condition when there is a significant difference between the dioptric power of the two eyes, but they each have the same type of error.
I.e. OD + 1.25 / OS + 4.50

ANTIMETROPIA: The refractive condition when the patient has one eye myopic and the other eye hyperopic. I.e. OD +2.25 / OS -1.50

APHAKIC: A patient that has had the natural crystalline lens of the eye surgically removed due to a cataract and, no implant (IOL) has been put in its place.

ASTHENOPIA: A vague term that is used to describe eyestrain without making a determination as to its cause. Symptoms may include nausea, vomiting, headaches at the browline or base of the skull, perceptual difficulties, reduction in depth perception, ocular pulling sensations and general feelings of being ill at ease. Common causes include spectacles with non-prescribed prism such as spectacles with the patient's PD beyond tolerance, inappropriate pantoscopic or retroscopic tilt, inappropriate face form, inappropriate base curves, or the wrong vertex distance.

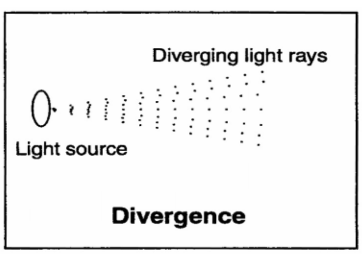

Figure 1

DIVERGENCE: The spreading out of light equally in all directions from the light source. According to accepted optical theory and parameters, light is considered diverging until it reaches 20 feet. This distance is called optical infinity because light rays are considered parallel here. Ocular examinations are performed at 20 feet because the normal human eye is at rest when viewing objects at this distance and the light from 20 feet will not influence the RX outcome since it is parallel. See figure 1.

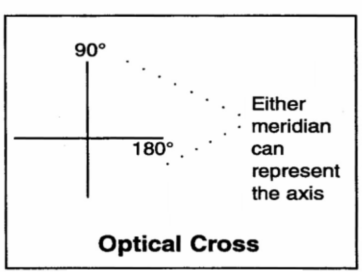

Figure 2

OD: Oculus Dexter - right eye

OPTICAL CROSS: A diagram that represents the powers of a given prescription lens in its primary meridians. The primary meridians are the prescription axis and 90° away. Figure 2 shows the location of maximum and minimum power in any lens. Once the extremes are known, all other points of interest are found between them.

When light enters a prism, it is deviated toward the base, while the image is perceived as shifting toward the apex.

Figure 3

PRISM: A wedge shape piece of optical quality glass or plastic which has a thin edge, called the apex, and a thicker edge, called a base. A prism displaces light, but does not focus light. Prism is denoted by the symbol Δ.

OPTICIAN: One who is extensively trained in the interpreting of ophthalmic prescriptions and applies that knowledge to obtain the optimum visual and safety performance for the patient in a pair of spectacles or contact lenses (Ophthalmic Dispenser) (Thomas, 1996).

OS: Oculus Sinister - left eye

OU: Oculus Uterque - pertaining to both eyes

PHOROPTER: An examination device utilized by the refractionist to perform an ocular refraction. The device contains lenses of various dioptric powers and auxiliary lenses for testing many ocular anomalies. Alternately, the refractionist can use a trial frame with loose lenses to perform the same function.

PRESBYOPIA: A refractive error which makes it difficult for the patient to view objects in the near field, such as traditional reading distance. The condition begins to affect people at or near the age of forty. Essentially, it is caused by a reduction in the accommodation power of the crystalline lens.

VERTEX DISTANCE: Generally, the distance between the back vertex of an ophthalmic lens and the corneal apex of the patient. Most refractionists utilize approximately 13 mm during examinations (Thomas, 1996). In ophthalmic prescriptions of over + or - 6.00 diopters, either matching this distance or compensating the prescription for a new distance becomes paramount.

// : An optical symbol which denotes, 'combined with.' It is most frequently used to include prism as part of an ophthalmic prescription. Alternately, the symbol ⌣ may be used to also designate 'combined with'.

Introduction

One of the more prominent, albeit less noticeable, aspects of the art and science of opticianry is the constant reliance on our own value system in order to guide the patient into the appropriate optical devices. Naturally, we do this to maximize their visual performance and safety. Or do we? In other words, why do we make the decisions that we make on a daily basis? So much of the optician's work is in the realm of ambiguity that we need to look within ourselves to find the rationale for the myriad quantity of decisions we are responsible for each and every day. The obvious question is whether or not this guidance is truly in the best interest of the patient given the individual circumstances. The next question is who gets to decide the appropriateness of any one decision made for the welfare of any individual patient. While there are certainly situations that are strikingly clear on both sides of any ethical discussion, the vast majority of most optical decisions are going to fall into the gray void of debate. However, there are resources which can help to guide us through this void.

To begin with, if we have a clear understanding of the origins of opticianry law, their basis in long-standing ethical practice, and a direct application to these sometimes blurry margins, we can at a minimum make informed decisions and judgments. Ultimately, one of the clearest tests for the so-called correctness of our decisions is the quality of the patients' vision. In this instance, we have an objective measure of the quality of our subjective decisions. This is an area that will encompass a significant portion of this course. While we will discuss the origins of law, especially the minimum standards and tolerances that govern our profession, the differences between ethics and law, and discuss scenarios which are ambiguous in their outcomes, we will also look at the standard Snellen visual acuity system and evaluate the quality of some decisions against this objective standard. With regard to opticianry, there is probably no more valid an evaluation than viewing the world literally through our patients' eyes. It may be hard to argue against the value of any of our decisions if the resultant visual acuity of the patient is maximized. Likewise, it may be difficult to defend a decision that impacts negatively on our patients' visual acuity. More importantly, we will address several issues that are commonplace occurrences in opticianry which have decidedly negative impacts on visual acuity, yet they are perceived as perfectly acceptable practice.

Ethics Versus Law

All of opticianry is governed by a variety of laws. Frequently, these laws will vary from state to state and even vary as to the scope of practice they purport to govern. What is considered an illegal activity in New Jersey may not even be addressed in the laws of Nevada and vice versa. However, one common denominator for all of opticianry is the minimum standards and tolerances. Essentially, these standards are a guideline for what is acceptable to dispense when the completed spectacles are not perfect. Although these will also vary from state to state, there is an applicable standard wherever opticianry is practiced. On the other hand, the ethical standards of opticianry are very much an individual issue without necessarily any attachment of law.

If we attempt to analyze the fundamental differences between law and ethics, we can identify some essential disparities as well as some very common ground. At the most fundamental level, we can say that you might feel uncomfortable if you violate your ethical standards, but you may end up paying legal penalties if you violate the law. Oddly, most laws have their roots in long-standing ethical standards. The laws are created when the ethical standard needs to be enforced. In other words, when the desired behaviors - ethics, are not being practiced, society demands laws to enforce the behavior (Hall, 1994).

An example of this cycle would be the New Jersey seat belt laws. Several years back New Jersey society decided that all citizens had the ethical responsibility to wear a seatbelt while driving. This decision was based upon many years of research into automobile accidents and the types of injuries suffered by both those who wore seat belts and those that did not wear seat belts. There were years of public awareness campaigns encouraging people to wear the belts. This ethical request proved to be ignored by the majority of the public so consideration was given to make the request a law. However, there was some resistance to making the wearing of a seat belt a law. The compromise that was struck dictated that a driver could not be stopped and ticketed for only a seat belt violation. However, if they were stopped for some other rationale and were not wearing a seat belt the police could issue a violation for the seat belt as well as the initial reason for stopping the motorist. So, here we have an ethical request by society (wearing a seat belt voluntarily) that research showed was being ignored by drivers. This request then evolved into being coupled with a minor attachment of law to help enforcement of the ethical request. Did it work? Absolutely not! After a couple of years and a high rate of documented non-compliance, New Jersey created a seat belt law that made it a first offense stop for the police. This example shows the full spectrum of an ethical request evolving into a partial law and then an actual law to ensure compliance with the initial ethical request. In contrast, if motorists in New Jersey had complied with the initial ethical request in sufficient numbers there never would have been a law created to enforce that request.

Herein lies a significant difference. Laws carry the implication of force and penalties for their violation. They use words such as “must,” “shall,” and “will.” Ethics, however, are primarily reliant upon persuasion and the individual’s conscience. Ethics uses words such as “should,” “may,” and seem to say, “it would be nice if you would.” While there is force implicit in all laws and ethics only identifies desired behavior, both entities are guidelines for our behavior. The irony is that if we choose to ignore an ethical standard that society values, society will frequently demand that the standard becomes a law in order for it to be enforced such as in the seat belt scenario. In this fashion, we can think of ethics as precursors to laws. Unfortunately, this distinction is not always so clearly defined. For instance, if your opticianry practices are ethical, they are most likely legal as well. However, if your opticianry actions are legal, they may very well not be ethical. We can analyze this concept by utilizing a presbyopic prescription and the applicable laws (Hall, 1994).

Visual Implications of Unethical Behavior

A patient visits your dispensary with the following prescription:

OD +3.00 - 1.00 X 90
ADD: + 2.00

The prescription is for the OD only because the patient has no usable vision in his left eye. During the initial fitting, you select appropriate frames, verify base curves, design the lenses, and take all necessary measurements including his binocular PD as 64/60.

Once the spectacles are fabricated you perform the final inspection and record the results as:

OD + 2.87 - 1.12 X 88 // 1/3 Δ Base Up
ADD: +1.87
PD off spectacles: 66/62

Obviously, the question is whether or not these spectacles are dispensable in their finished form. Since they have not been fabricated perfectly, we have the optical minimum standards and tolerances to reference and assist us with our decision. But before we even address that legal aspect, we should analyze the prescription in some detail. Let us analyze the prescription through the use of a series of optical crosses.

We can define the discrepancy between the prescribed power and the dispensed power by analyzing the dioptric difference in each primary meridian of the prescription. For the distance RX, the power at the 90th meridian is off by -0.12 diopter. In the 180th meridian, it is off by -0.25 diopter. For the nearpoint power, the power in the 90th meridian is off by -0.25 diopter and the 180th meridian is off further by -0.37 diopter. There are probably those among us that would analyze the dioptric power difference and conclude that it was perfectly acceptable. However, we should consider the overall impact on the patient’s visual acuity first and foremost as we indicated in the introduction of this course.

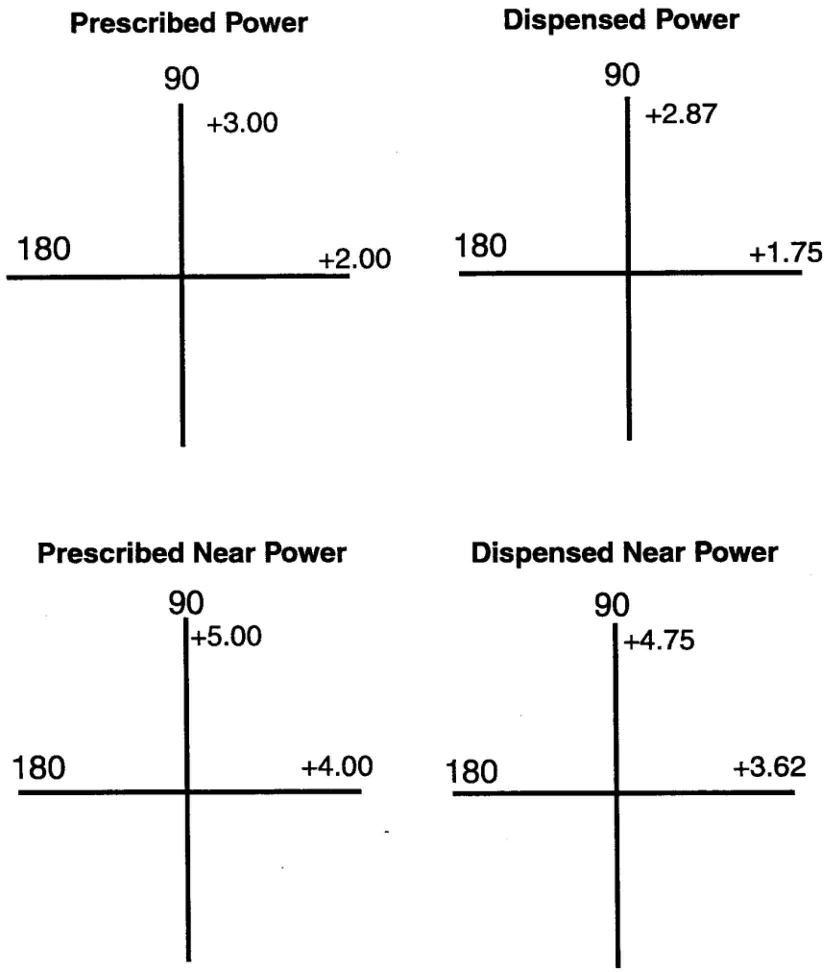

Figure 4

THE SNELLEN VISUAL ACUITY SYSTEM

In 1862, a Dutch ophthalmologist, Herman Snellen, devised a standard means of measuring a patient's visual acuity. He utilized his assistant, who had extraordinary vision, as the test individual for his experimentation. Apparently, his experimentation was a fabulous success because we still use his system today. There may be variations, but the essence of Snellen's work is used daily by millions (Stimson, 1978).

Snellen's system is the ultimate mathematical model. Once you understand his principle, the mystery is removed from this procedure. Through experimentation and trial and error, Snellen arrived at the conclusion that the acceptable standard for perfect human vision would be when the person could recognize a point that produced a visual angle of one minute. He also chose a distance of 20 feet as the standard testing distance. This distance is significant because light rays are considered parallel at this point. If an eye exam is given at a lesser distance without compensation, the patient will receive the wrong prescription due to the diverging light rays. Working from this premise, Snellen established the size of the letters on the 20/20 line as well as the Snellen fraction. The fraction system was developed to provide a practical assessment for acuity. When a patient cannot read the 20/20 line at 20 feet, the refractionist needs to determine his best visual acuity. Therefore, Snellen mathematically increased the size of the letters so that the patient would not have to ordinarily move. The 20/40 line, for example, contains letters exactly twice the size of the 20/20 line. The 20/60 line contains letters exactly three times the size of the 20/20 line. In fact, you can easily determine the letter size at any point on the chart. The 20/20 letters are 8.87 mm in height. If you invert the Snellen fraction for any other line you will get a whole number. For instance, the 20/200 line becomes 200/20 which is ten. Multiply ten times the 8.87 mm and you have the letter size of 88.7 mm (Reinecke & Herm, 1983).

INTERPRETING THE SNELLEN SYSTEM

As for the one minute visual angle, Snellen devised letters that would only be recognizable if the patient could distinguish the individual parts of the letter which formed the one minute angle. The entire E, for example, makes an angle of five minutes, but each leg forms an angle of one minute. Therefore, the patient can only distinguish this letter when it is on the 20/20 line if he has "perfect vision" and can distinguish the angle of one minute when it is separated by a space of at least one minute (see figure 5). Through his research with his assistant, Snellen surmised that the best vision a human could see was 20/10. This would mean that the person could see at 20 feet what a person with normal vision would need to move into 10 feet to see. Interestingly, decades later we found out through the invention of the electron microscope that Snellen's research was correct. The best vision that a human can manage is 20/10 visual acuity due to the limitations of the physical size of the cone photoreceptor cells in the retina. Cone cells provide our most distinct and detailed vision.

The Snellen fraction standardizes this measurement. If someone has perfect vision they would be given the Snellen fraction of 20/20. This means that they can see at 20 feet what they should be able to see at 20 feet (in countries utilizing the metric system 20/20 is replaced with 6/6. The sixes are in meters and are the approximate equivalent of 20 feet). The numerator is always the test distance, usually 20 feet. The denominator represents the size of the letters the patient could distinguish at this distance. For example, the fraction 20/40 means the patient can see at 20 feet what a person with perfect vision could distinguish at 40 feet (Reinecke & Herm, 1983).

RECORDING THE SNELLEN FRACTION

Taking a patient's visual acuity follows a set pattern. The OD is done first, followed by the OS. Finally, the visual acuity (VA) is taken with both eyes. Generally, the patient will see slightly better with both eyes than they do with either eye individually. Recording VA also has definite rules. A patient does not earn the designated line until they have read one letter more than half of that particular line. If the line has eight letters on it then the patient has to read five letters correctly in order to receive credit for that line. If they miss some of the letters then their vision would be recorded as that line minus those letters. For instance, suppose someone is trying to read the 20/20 line: DEFPOTEC. There are eight letters on that line so they must read five correctly to receive credit for the 20/20 line. Suppose they only read five letters correctly. Their vision would be recorded as 20/20 – 3. But what if they have extraordinary vision and read two letters of the next line after 20/20? In that case, their vision would be recorded as 20/20 +2 (Carlson, 1990).

The entire letter forms an angle of five minutes if measured from top to bottom or side to side.

Each leg of the letter and the space between them is an angle of one minute.

Figure 5

They should be able to see this, but they cannot

THEY CAN SEE THIS!

The Patient's Visual Acuity

Now, let us assume that the patient we were discussing in our prescription example has the ability to obtain 20/20 vision. Based upon this assumption, we can analyze the effect the imperfect spectacles might produce.

With the established dioptric power difference, the patient’s best corrected visual acuity for distance would be 20/25 according to Egger’s rule where you lose one line on the Snellen chart per .25 D (Stimson, 1978). The near acuity would be 20/30+, putting them between 20/25 and 20/30. However, we are not finished. Let us suppose the patient’s spectacles contain the ever popular cosmetic tint of 10% pink or a similar tint. The combined effect of the power discrepancy and the tint would result in a distance acuity of 20/50. Furthermore, if the patient drives at night with a tinted windshield, his acuity would drop to 20/70 or worse. Naturally, this combined effect on the near acuity would be even more profound since there is a larger power discrepancy (Brooks and Borish, 2006).

20/70 is obviously poor vision, but what exactly is the quality of that type of vision? Mathematically, the patient would only be able to recognize letters that are 31.04 mm high instead of the standard 8.87 mm size. In other words, his vision is three and a half times worse than normal. To calculate this, simply invert the original Snellen fraction – 70/20 and divide to get the answer of three and a half times worse vision. Figure 6 shows this disparity visually.

Furthermore, the patient would not only suffer visual impairment (20/70 best corrected VA is the legal foundation for the visually impaired, and is not even the minimum vision required for a drivers license in most states), but he would likely suffer asthenopia. Asthenopia is a descriptive term for visual discomfort. The symptoms include general discomfort; eyestrain; ocular fatigue; systemic fatigue; general malaise; headaches at the brow line, base of the skull and forehead; an ocular pulling sensation; nausea; and possible psychological ramifications. All of this is being produced by a pair of spectacles that are legal to dispense according to the toughest standards in the nation. The original prescription was created by making each individual component of the prescription off by the limit allowed by the New Jersey minimum standards and tolerances. These tolerances are established in part by the original ANSI Standards from 1972. To make matters worse, most states rely on current ANSI Standards which are far more lenient. ANSI stands for American National Standards Institute. This is a private corporation based in New York City that prepares standards for any number of industries. It is up to government agencies, such as optical state boards, to decide if they wish to adopt their standards. ANSI standards for the optical profession have consistently and significantly weakened since they began in 1972. The NJ State Board of Ophthalmic Dispensers has refused to accept these weakened standards and insists upon utilizing the original stricter standards (General Rules and Regulations: Ophthalmic Dispensing Act of 1969).

The point is clear. This may be a perfectly legal pair of spectacles to dispense to the American public, but is it ethical? Considering the extent of the impact demonstrated, it should be plain to see that the ethical implications are far worse than the legal implications. Ask yourself if the optician who decided to dispense this pair of spectacles would be comfortable if he knew that the patient receiving these spectacles was his pharmacist, RN, dentist, CPA or surgeon (General Rules and Regulations: Ophthalmic Dispensing Act of 1969).

With regard to the tinting of ophthalmic lenses, we should consider yet another possible problem. Although some aspects are debatable, Irlen lenses are utilized in the treatment of learning disabilities. These lenses are dispensed with extremely precise tints. The theory is that the learning disability is caused by over-stimulation of the retina by certain wavelengths of light. Irlen calls this condition Scotopic Sensitivity Syndrome (SSS). By absorbing these wavelengths with the precise tints, the disability can be improved or eliminated. The point is this: if the use of a tint can relieve a learning disability, is it not possible, when indiscriminately prescribing a tint, to cause people more harm, especially if the patient happens to have a learning disability?

Vertex Distance Compensation

Another optical dilemma that bears consideration is vertex distance compensation. This is another often overlooked portion of opticianry. Vertex distance is the distance measured in millimeters from the patient’s corneal apex to the back surface of the spectacle lens or examination device. The statistical average for vertex distance has been calculated repeatedly as 13.75 mm (Stimson, 1978). Naturally, this distance will vary with the individual and must be measured for each and every patient. When prescriptions reach a dioptric power of beyond + or - 6.00 diopters, this distance becomes quite critical. As long as the examination distance and the spectacle distance are the same, there is generally no problem. The optical dilemma occurs when these two distances do not match.

Suppose a patient came into your dispensary with an RX that reads:

OD - 0.75 sphere
OS -1.25 sphere

Would you hesitate to fill this prescription? Probably not. Why? You might answer that the function of filling this prescription accurately would improve the quality of the patient's vision and hence, the quality of his/her life altogether. Keep this thought in mind as we delve into vertex distance compensation.

The one and only optical principal involved in vertex distance compensation is simply distance. The patient is examined with the refractionist's trial frame or phoropter positioned at a specific vertex distance from the eyes. If the subsequent spectacles sit at a different distance and contain enough dioptric strength, then the effective prescription will not be what was intended. Whether the prescription is plus or minus, and whether the spectacles sit closer or further away from the examined distance, will dictate if the effective prescription is too weak or too strong. Essentially, the resultant problem breaks down into four rules:

- A plus lens moved away will become effectively stronger
- A plus lens moved closer will become effectively weaker
- A minus moved away will become effectively weaker
- A minus lens moved closer will become effectively stronger

In each instance, we are referring to where the final spectacles sit compared to where the original examination took place. In other words, when determining the effect to the prescription, always begin with the examined distance and move to the spectacle distance. Measurement of this distance is generally accomplished via an instrument called a distometer (see figure 7). This hand-held instrument is placed gently on the patient's closed eyelids and a plunger is depressed until it reaches the back of the spectacle or trial lens. The vertex distance is then simply read off of a scale. In the case of the phoropter, most have a mounted scale for the purpose of measuring vertex distance. When attempting to measure this distance before the prescription is filled, the

Figure 7 (West-op.com, 2018)

A distometer & an RX compensation dial

optician has to improvise since there are no finished lenses in the frame. Some opticians simply adjust the frame properly and measure the vertex distance with the demo lenses in the frame. Since ophthalmic frames are usually on a six diopter base curve, this will only serve as an estimate. Others prefer estimating the back curve and try to simulate its depth with the use of tape on the frame. In the instance of a high plus prescription, the optician would want to simulate a -3.00 back curve as that is commonly utilized in that scenario. For higher minus lenses, the back curve would be a great deal steeper and, as a result, that much more difficult to simulate but simulate we must. Again, this will only serve as an estimate. Regardless, the optician has to feel comfortable that he/she can duplicate this distance with appropriate adjustments when the final fitting occurs. It is generally helpful to utilize a frame with adjustable nosepads with arching guard arms in these cases so that the final vertex distance can be controlled. If the measured distance of the spectacles match the refractionist's vertex distance, then all is fine. However, if there is a discrepancy, the original prescription must be altered to arrive at the appropriate prescription on a case by case basis. Not altering the original prescription would be tantamount to filling the wrong power and could be interpreted as professional negligence.

Vertex Distance Compensation Formula

The formula for this calculation is relatively straight forward. The formula works most easily in millimeters because that is the unit of measurement for the vertex distance and because it relates well to diopters. The formula is as follows:

$$\text{Power} = \frac{1000\text{ mm}}{\text{focal length + or - distance moved}}$$

where the power is either the power the lens should be made when sitting at the new vertex distance in order to function like the original prescription was intended or the effect this lens will have to the patient if compensation is not done. The formula will give you either answer depending on how it is employed. The focal length is of the original prescription and is found by dividing the diopters into 1000. The addition or subtraction refers to the difference between the original vertex distance and the spectacle distance, expressed also in millimeters. Whether this difference is added or subtracted will vary with the particulars of each case. Perhaps an example will help to clarify this equation.

An elderly cataract patient arrives at your dispensary with the following prescription:

OD + 12.00 D sphere
OS + 15.25 D sphere
ADD: + 2.75 OU
Vertex Distance = 11 mm

When you complete the frame fitting, you find that due to a protruding brow-line, the spectacles sit at a 16 mm vertex distance. Using the above rules, we know that this will result in a prescription that is too strong for the patient. In order to determine exactly how much stronger the prescription would be if we do not compensate the original RX, we need to use the formula.

OD:

$$\text{Focal length} = \frac{1000}{+12.00} = 83.33\text{ mm}$$

The difference between the examination vertex distance and the spectacle vertex distance is exactly 5 mm. We need to apply this to our formula to calculate the effective prescription. Since we want to know the effective prescription, we will subtract the difference in vertex distances from the focal length. This will give us an answer that is greater than the original prescription. From our rules, we know that this is the effect we will get under these circumstances.

$$\text{RX} = \frac{1000}{83.33 - 5\text{ mm}} = +12.76\text{ Diopters optical notation} = +12.75$$

+12.75 minus +12.00 is +0.75 diopters, we would over-correct this patient by that amount if we do not alter the original prescription. (In optical notation, the compensated RX would be +11.37)

OS:

$$\text{Focal length} = \frac{1000}{+15.25} = 65.57\text{ mm}$$

Again, we will subtract the 5 mm difference in our formula.

$$\text{RX} = \frac{1000}{65.57 - 5\text{ mm}} = +16.50\text{ Diopters}$$

In this case, we have + 16.50 minus +15.25 D. This eye would be over-corrected by +1.25 diopters if the prescription is not compensated for the new vertex distance. (In optical notation, the compensated RX would be +14.12)

Now we need to review the ramifications of this example. We have established that the OD would be + 0.75 D too strong and the OS would be + 1.25 D too strong. What impact does this have on the patient? Does wearing extra plus power effect vision? Will it simply be something that needs to be “worn and you will get used to it”? Obviously, a hyperopic or aphakic eye requires plus power because it simply does not have enough dioptric strength to focus light rays on the retina (see Figure 8). Without the plus power of the artificial spectacles, light rays from distant objects would be out of focus by the time they reach the retina. Theoretically, they will focus somewhere behind the retina.

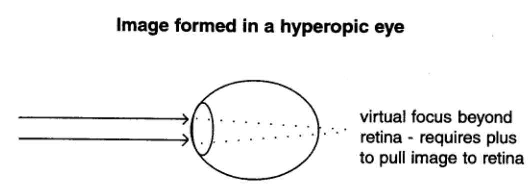

Figure 8

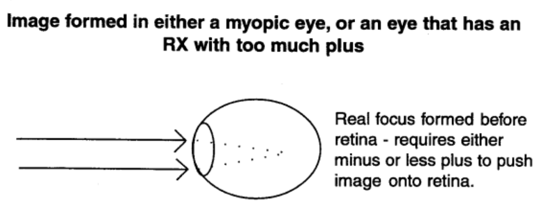

Figure 9

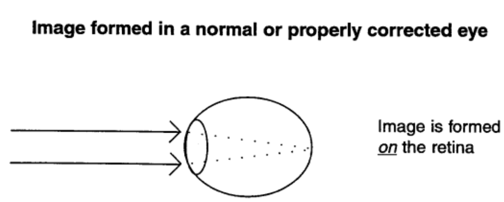

Figure 10

In myopia, the reverse scenario is true. A myopic eye is actually too strong. Light rays from distant objects will focus before they reach the retina. Myopic eyes require minus lenses to push the image back onto the retina and effectively weaken the eye.

If our patient does not have the prescription compensated, he will not have the appropriate prescription before his eyes. If the prescription contains too much plus, he will actually become myopic (see Figure 9). In this case, if the patient wore the spectacles without the vertex compensation, his effective prescription would be:

OD - 0.75 D sphere
OS - 1.25 D sphere

This happens to be the exact prescription that you probably agreed you would fill without hesitation a few paragraphs back. Simply paying attention to the vertex distance when fitting higher powered prescriptions like this can make the difference between 20/20 vision (see Figure 10) and significantly diminished vision. If the same diopter change occurred for a myope – resulting in too much plus power in the eye (or not enough minus in the RX) - it would create a similar result. He would leave the dispensary still a myope and with equally diminished visual acuity. Since the myope does not have enough minus in this instance, there is nothing that he could do to clear his vision. Accommodating would only increase his myopia.

The Prismatic Effect of PD Error

In all likelihood, we are all well aware of the prismatic effect created if the optical centers are not properly aligned in a pair of spectacles. Depending on whether the prescription is plus or minus power, the patient will receive a base in or base out error. However, there is one consideration regarding patient pupillary distance that may be overlooked. The item in consideration is the utilization of binocular versus monocular pupillary distances. It is quite possible to create a pair of spectacles that contain a significant prismatic error while the patient's PD is perfect.

Although most of us are unwilling to make the admission, we are far from symmetrical. One eyebrow, cheekbone, or eye is most often higher, lower or closer to the center of our face than the other. When we utilize a binocular PD, even for the simplest of prescriptions, we are running the risk of creating unwanted prism for the patient without even realizing that this has occurred. When the prescription is significantly anisometropic, the resultant prism error can be dramatic even though we may think the spectacles are perfect. Consider the following example:

OD - 4.50 - 1.00 X 135
OS - 1.50 - 0.50 X 45
Patient's binocular PD = 64

Let us assume that the spectacles are fabricated accurately according to these parameters. However, suppose that the patient's monocular PD is actually 34 mm for the OD and 30 mm for the OS. The fabricated lenses would each be 32 mm from the center of the bridge. Since each lens is now off 2 mm, we can calculate the prismatic effect that the patient would receive.

PRENTICE'S RULE FOR DETERMINING PRISM POWER

The formula for calculating prism error is:

$$\Delta = \frac{\text{Diopters x distance from OC}}{10}$$

Where:
Diopters = the dioptric power in the meridian of consideration and
Distance from the OC = how far the optical center is away from the PPD.

In this instance, we will need to calculate the dioptric power in the 180th meridian since our concern is regarding the pupillary discrepancy. In each eye, the RX axis is 45° from the 180 meridian. There is exactly one half of the cylinder power 45° from the axis of any prescription.

For the right eye, this means that there is -0.50 cylinder power at 180 which, when combined with the sphere, gives us a total power of - 5.00 diopters. In the OS, we have a total power of -1.75 diopters. Since we already know that each lens is off 2 mm,
we can now use Prentice's rule.

$$\Delta \text{ OD} = \frac{5.00 \times 2}{10} = 1.00\Delta$$

$$\Delta \text{ OS} = \frac{1.75 \times 2}{10} = 0.35\Delta$$

While we now have a quantity for prism, we need to determine base direction in order to have the full story. Since minus lenses can be thought of as two prisms apex to apex, we can diagram the base direction as shown in Figure 11.

In the case of horizontal prism, opposite base directions are subtracted from one another to arrive at the full prismatic effect. Here we have 1 prism diopter base out in the OD and 0.35 prism diopters base in in the OS. The net effect to the patient is still 0.65 prism diopters of unwanted prism on a pair of supposedly "perfect" spectacles. Imagine the error if the finished spectacles were off a little, if the patient was more asymmetrical, if the prescription were more anisometropic or if the prescription was simply stronger in power.

The point is this: ***ALWAYS*** take and use monocular patient PDs with a corneal reflection pupilometer type device. You will definitely find that the symmetrical patient is the rarity and the unsymmetrical patient the norm.

Case Studies in Opticianry

The one aspect of opticianry that no one can deny is that every day brings new and different challenges. Opticianry is every bit as much an art as it is a science. We often are presented with situations that are far from clear and direct. However, careful consideration and critical thinking can help us to arrive at the appropriate decisions. The following four scenarios are very much real world in nature. After reviewing the information provided, try to establish your own series of questions and your own opinion. At the end of each scenario, we will discuss some of the possibilities.

CASE # 1:

A patient enters an optical office with a new pair of spectacles which were purchased elsewhere. The person complains that his vision just does not seem "right." He voices the concern that the eyeglasses may have been made incorrectly and wonders if they can be checked. At this time the patient also produces a copy of the prescription that the spectacles were made from. The optician tries in vain to determine the specific complaint regarding the new eyeglasses. The patient's response to the questions are so vague that it clarifies nothing. The optician then checks the eyeglasses and finds that the prescription is accurate. After further discussion with the patient, the optician discovers that the patient's symptoms only occur binocularly. The optician then decides to check the patient's and spectacles' pupillary distance and discovers a significant error of 6 mm.

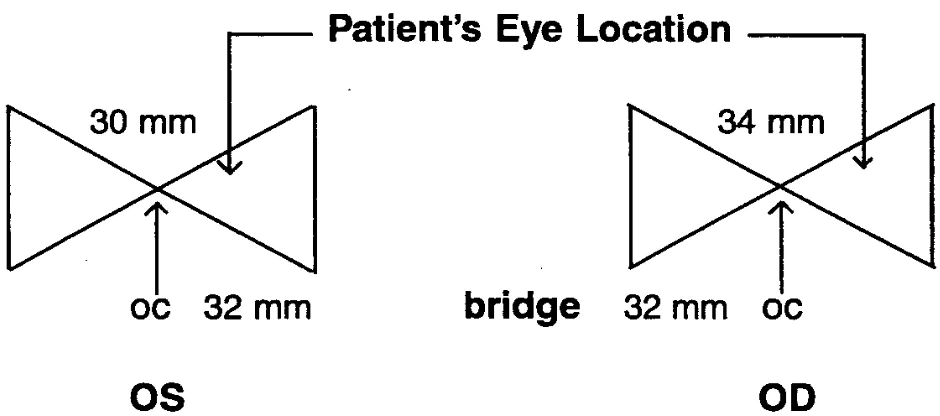

Figure 11

QUESTIONS RAISED: Since the optician has the prescription, the discrepancy in pupillary distance is a prescription error. Do you tell the patient this fact? How do you express the information to the patient? Is there an ethical obligation to disclose this information to the patient? Is there a professional obligation (real or imagined) to withhold this information from the patient? Are there professional ramifications to disclosing this information to the patient?

OUTCOMES: Since there is a prescription involved, the optician knows that there is no possibility of horizontal prism having been prescribed. The patient should be told that there is a discrepancy between his physiognomic measurements and that of the new spectacles. This could very easily explain the rather vague and ambiguous complaints from the patient. A spectacle PD off by this much can induce prism which will in turn cause asthenopia. The patient should then be directed back to the original optician in order to have the situation rectified. The patient should also be informed of the role of the State Board in case he meets resistance from the original optician.

CASE # 2:
A patient enters an optical store visibly upset. The patient states, while trying hard to maintain his composure, that he has just come from the doctor's office. The doctor has informed the patient that the reason he has been having difficulty with his new spectacles is because the optician made them incorrectly. The patient then demands a refund and the address of the optician's State Board. The optician is shocked and confused. He tries to discover exactly what is wrong with the spectacles. The patient angrily replies that they are the wrong powered lenses and throws a note from the doctor on the dispensing table. The 'note' is nothing more than a prescription for the left eye with the comment, "please change OS." When the optician checks the patient's record, he discovers that there is nothing wrong with the spectacles and that the doctor has made an error in prescribing the original RX and is now asking the optician to correct that mistake.

QUESTIONS RAISED: Obviously, either the doctor or the patient made an error during the examination. However, the doctor seems to have implied that the error was the optician's in an attempt to shift the blame. Does the optician accept the blame? Does the optician explain to the patient that it was the doctor's error? How does the optician explain the error? Does the optician confront the doctor with the situation?

OUTCOMES: The patient should know where the error originated. It serves no purpose for the patient to be ignorant of the facts. The optician can simply produce the original prescription to demonstrate the prescription change made by the doctor. Patients will frequently feel loyalty to the doctor in these situations. They will also resist your explanation by explaining that they do not understand ophthalmic prescriptions. A simple demonstration showing how the 'numbers' have changed is hard for the patient to refute. Explaining how such a change can be manifested, either by the patient's responses or the doctor's error, can also be accomplished. The optician should also approach the doctor to establish an improvement in the doctor's value system. Allowing a potentially adversarial relationship to develop will not help the doctor, optician, or the patient very much. However, addressing this scenario calmly and directly will hopefully set the course for an improved relationship between the doctor and the optician, and ultimately, their patients.

CASE # 3:
This is a duplicate of case number one, except that the eyeglasses were made by the optician, and this is his patient. Somehow, these spectacles were dispensed while being beyond the minimum standards and tolerances. After the optician has finished with the patient, he discovers that an apprentice in his employ was responsible for the error and the subsequent dispensing while the optician was momentarily out of the office.

QUESTIONS RAISED: This is a clear case of error on the part of the optician and the apprentice. Does the optician accept responsibility for the error? Does the optician disclose the error to the patient? How does the optician explain the error? Does the apprentice become a scapegoat?

OUTCOMES: Since an unfortunate set of circumstances occurred which led to the dispensing of poor quality spectacles, the optician should accept full responsibility for the error and offer restitution to the patient. The patient deserves a full explanation, but without casting any blame on the apprentice. After all, the optician is fully and legally responsible for all that occurs in the optician's office. However, a discussion with the apprentice is in order to define his professional role and to establish a rigid office policy which will prevent a repeat scenario from ever occurring.

CASE # 4:
A patient comes into an optical office on the eve of a major holiday. He tells the optician that he is inquiring about the cost of a pair of spectacles for his son, who is age six. The patient seems considerably distraught over the prospect of paying for expensive spectacles, especially at this time of year. The optician asks to see the prescription in order to accurately discuss price. The patient hands over a prescription from a dispensing optometrist/ophthalmologist which reads:

O.D. -0.25
O.S. plano

COMMENTS: anti-reflective coating; ultraviolet filter; spring hinge frame; discuss polycarbonate.

As the conversation continues, the optician finds out that at least some of the parent's anxiety is due to the fact that his child has defective vision and he never noticed a problem.

QUESTIONS RAISED: Superficially, this appears to be a case of greed originating from the doctor. Does the optician explain the prescription and the fact that it is insignificant in strength? Does the optician simply fill the prescription without question? Does the optician attempt to elicit facts that would shed light on the purpose of the prescription? Is the polycarbonate suggestion significant? Could there be vision loss the doctor is attempting to preserve?

OUTCOMES: The optician has a professional obligation to investigate this scenario fully. Filling the prescription without an underlying rationale would be highly unethical.

There are two possible rationales here. One is simply greed with no redeeming justification. However, another rationale is to provide ocular protection due to the child's possible vision loss. Since there is no specific format for prescribing a balance lens, and since some patients are very sensitive to vision loss, it is quite possible that the doctor has every good intention in the world. If the patient does have a significant vision loss in the OS, then the suggestion for polycarbonate is certainly justified in order to preserve the existing sight. In addition, since the patient needs to wear protective lenses, he may as well wear the minor prescription prescribed for the OD. However, if vision loss is the underlying need in this situation, then the optician should question the need for an anti-reflective coating. Anti-reflective coatings, as well as other coatings, should always be omitted when safety is the predominant concern since they significantly weaken lenses (Young, 1995). John Young of Colts Laboratories has made this abundantly clear through his research. The optician has a professional, ethical and fiduciary responsibility to investigate these circumstances before making recommendations since those recommendations will reflect his/her professionalism and could possibly lead to professional liability (Thomas, 2018).

Conclusion

Hopefully, we have demonstrated through a variety of examples the complexity of opticianry and the even more complex world of ethical decision-making. While there will be times when we must rely solely on our instincts, there is also evidence that there are educational resources which will aid our way through these situations. One aspect is quite clear. As opticians, we cannot take our education for granted. For example, Irlen lenses and anti-reflection lens coatings were not even dreamed of when most of us were in college. These are but two area's that glaringly point out the need for thorough continuing education. Ignorance in opticianry can hardly be considered bliss. What it may very well be considered is poor visual acuity for our patients and possible professional negligence on our part. Remember, unethical behavior frequently leads to new legislation in order to enforce what we should have been doing in the first place.

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