

Assisting the Anisometropic Patient

An Overview of the Options Available

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“De medicine in these here peepers taint work’n you fix, no?” cried a highly frustrated and irritated patient. Not the best way to start your morning! Yet this is what makes the field of opticianry an exciting and challenging profession. It is a combination of technical prowess and an ability to relate to any given patient at any given time. The opening sentence begins a story of a patient who recently entered the optical clinic where I worked.

This aggravated patient had just purchased a new pair of eye wear from one of the optical shops down the street. After attempting to wear the glasses the patient returned to the store he purchased them from and complained to the sales person about his vision with the glasses. According to the patient, the sales person checked the glasses and stated that they were made correctly. The patient was then told that he should wear the glasses for two weeks, this would allow him to get used to his new eye wear. This insensitivity to the patients need’s brought him into our shop. After patiently listening to the patients view point the following Rx was obtained.

OD +6.00 +2.50 x 15

OS +2.75 sphere

ADD +2.75 OU

P.D. 64/61

The glasses were verified against the prescription and found to be correct. Further discussion with the patient determined that this was the first pair of multifocals the patient had purchased. The chief complaint was narrowed down to a near point difficulty.

To the experienced optician, it should come as no surprise that the near point difficulty was a double vision or diplopia effect. A series of options were presented to the patient who then selected the best option for him and a new pair of eye wear was made that alleviated the near point diplopia. When the glasses were dispensed the patient happily exclaimed that he would be returning for future purchases. A happy ending to a sad situation that could have been avoided at the time the first pair of eye wear was purchased from the initial optical shop. How? Had the optician at the first optical shop understood the concept of *Anisometropia* he/she could have created a pair of eye wear for the patient that would suit the patient's needs and prevented the difficulties that the patient had to encounter.

So, what is anisometropia? More importantly, how should the optician approach this challenging situation in order to best serve the needs of a patient?

Anisometropia is defined as, “ A condition of unequal refractive state for the two eyes, one eye requiring a different lens correction than the other”, (Schapero, Cline, & Hofstetter 1968). Anisometropia is further defined into two primary categories *antimetropia* and *isoanisometropia*. In the condition of *antimetropia* the refractive errors of the eye are of opposite signs and amounts as in: OD +3.00 and OS -4.00. Isoanisometropia is defined as “ A condition of equal refractive error but with differing dioptric power.” (Schapero et. al., 1968)

The category of *isoanisometropia* is subdivided into *anisomyopia* and *anisohypermetropia*. With anisomyopia the refractive state of the two eyes are both myopic yet there is a clinically significant difference in the dioptric power for each eye. An example of anisomyopia would be: OD - 2.00 and OS -5.50. The condition of anisohypermetropia presents the refracted error of hyperopia for both eyes with a clinical significance in the dioptric power. Anisohypermetropia can be illustrated by the following example: OD + 3.75 and OS +1.25.

Using the broad definition of Anisometropia, it becomes apparent that the majority of refractive errors that the optician faces daily would fit this description. This condition is common enough that there exists no study in which researchers have accurately pinpointed the occurrence of anisometropia in either the general population at large or in a sub population of individuals requiring corrective eye wear for visual improvement. Conservative reports indicate that 4.7% (DeVries, J. 1985) to 7.5% (Ingram, R.M., Traynar, M.J., Walker.C. & Wilson, J.M.,

1979) of children 5 years old or less exhibit anisometropic conditions. These estimates are considered to be inconclusive due to the population from which the subjects were selected and the criteria used in the studies for determination of anisometropia.

What researchers have found is that the condition of anisometropia can present severe asthenopia symptoms such as; aniseikonia, diplopia, loss of binocular function, stereopsis, and cosmetically unappealing eye wear (Thal,L.S. & Grisham,J.D. 1976). Whether a patient presents these symptoms or not can be dependant on the level of severity in their anisometropic condition. Anisometropia can be divided into three degrees of severity ; mild, moderate and severe. When the dioptic imbalance between the two eyes is two diopters or less the patient is considered as having mild anisometropia. If the dioptic imbalance between the two eyes is between two diopters and six diopters the degree of severity is considered to be moderate. When the dioptic imbalance between the two eyes is 6 diopters or greater the condition is graded as being severe. (Gettes, B., 1970).

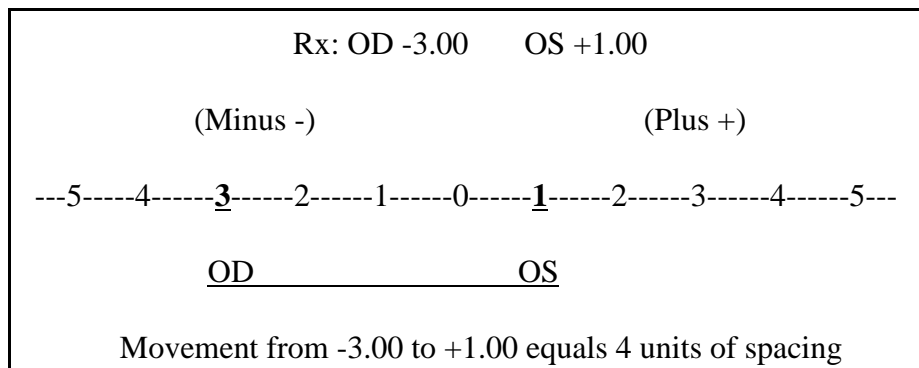
The dioptic imbalance between a patient's right and left eye for an isoanisometropic patient is calculated by determining the mathematical difference between the two refractive errors. As an example, for the anisomyopic patient with the following prescription the dioptic imbalance would be 3.5 diopters.

OD -2.50 sphere OS -6.00 sphere
$-2.50 (-) -6.00 = 3.50$

In the case of a patient with the following anisohypermetropic prescription there would be a dioptric imbalance of 2.75.

OD + 4.50 sphere OS + 7.25 sphere
$+4.50 (-) +7.25 = 2.75$

The dioptric imbalance between the two eyes for an antimetropic patient is determined by placing the refractive errors on a number line and calculating the spacing between the two dioptric units. The following example illustrates a dioptric imbalance of 4.0 D for an antimetropia patient.



The preceding illustrations demonstrate how to determine the dioptric imbalance for spherical prescriptions. When the practitioner is evaluating a cylindrical prescription, the spherical equivalent or just the spherical power for calculating the degree of anisometropia may be used. It is important to note that this calculation represents the dioptric imbalance for the purpose of assessing the degree of anisometropia (mild, moderate, severe).

Recognition of an anisometric prescription and its degree of severity is just the first step that an optician uses in dealing with this challenging situation. The second phase of assisting an anisometric patient is the decision as to whether corrective measures should be taken. When should the amount of anisometropia indicate the need for special attention by the fitter of the eye wear prescribed for the patient?

Opinions on this matter vary among the many authors on this subject. Most researchers agree that when the patient presents the symptomatic effects of ; 1) diplopia during acentric gaze, 2) loss of depth perception or stereopsis, 3) blurred vision due to aniseikonia, or 4) complaints of eye fatigue or extreme headaches without other pathological or mental causes, the practitioner should address an issue of anisometropia.

However, one should not ignore the asymptomatic patient (Thal, et. al., 1976). Failure to attend to a patient who, despite a lack of symptoms, has a refractive error of anisometropia can be a extreme disservice to the patient.

When determining the need for corrective measures the following guideline is suggested by most researchers:

Table One: Degree of dioptric imbalance	
1.00 D or less of imbalance	Do not correct
Greater than 1.00 D. but less than 5.0 D of imbalance	Correct
Greater than 5.0 D of imbalance	Correction may be futile

This guide was developed by Dr. V.J. Ellerbrock in the late 1940's and is still supported by modern researchers on this topic (Ellerbrock, V.J.,1948).

In the interest of brevity, the remainder of this paper shall deal with the elimination of the diplopic effects that can be encountered by the anisometric patient. This is not meant to trivialize the aniseikonic effects caused by different image size created due to disparity in refractive error between the two eyes. While this effect can also create great discomfort the majority of the researchers in the area of anisometropia have been able to determine that the diplopia effects are of greater concern to the patient and practitioner.

After determining the need for taking corrective actions to alleviate the anisometric effects for a patient the optician can select from many methodologies. For the patient who presents a single vision anisometric correction the optician can recommend a slab-off or biconcentric grind, head tipping training, vertical optical center placement, or contact lenses.

Research has shown that the most successful remedy for the single vision anisometropia is head movement training. The premise of this methodology is that the symptomatic effects of the anisometropic condition can be minimized if the patient can keep his / her visual axes in line with the optical centers of the prescribed eye wear. By controlling the degree of movement (decentration) of the patient's eyes off the optical center of the prescribed eye wear the patient can eliminate the prismatic imbalance that would otherwise occur.

This effect can be illustrated by using Prentice Rule formula. Prentice Rule states that “the prismatic affect (in prism diopters) is the product of the linear distance from the optical center (in centimeters), and the lens power (in diopters) in the meridian of rotation.” (Michaels, D., 1982). Applying Prentice Rule to a single vision anisometropic prescription would result in the following illustration.

Prismatic Effect due to visual rotation off optical center placement of corrective lenses	
Rx: OD +6.50 OS +1.75	
Patient engages in a 15 mm Supraversion gaze.	
<u>OD: +6.50</u>	<u>OS: +1.75</u>
1) Prentice rule : $P = H(\text{cm}) \times D$	
<i>P= Prismatic error in prism diopters, H(cm) = decentration in centimeters, D= Dioptric power of the lens in the meridian of rotation.</i>	
2) $P = (1.5) \times +6.50$	2) $P = (1.5) \times +1.75$
3) $P = 9.75 \text{ BD}$	3) $P = 2.625 \text{ BD}$
The total prismatic error for this patient must be determined by subtracting the prismatic effect for each eye. $9.75 \text{ BD} - 2.625 \text{ BD} = 7.125 \text{ BD}$ prism diopters of imbalance	

Using the preceding example the patient with this prescription would experience about seven and one eighth diopter's of imbalance when he/she rotates his/her eyes off the optical center of the prescriptive eye wear. This prismatic effect could cause any of the classic anisometropic symptoms and thereby cause the patient discomfort. The patient can reduce this discomfort by decreasing the amount of time spent in the off center gaze position. This is easily done in most non primary gaze positions such as left, right, upper gaze and angular movements. By moving their head in the desired direction the patient can keep their visual axis in line with the optical centers of the eye wear.

The patient will generally experience the greatest discomfort during convergence. This eye rotation occurs whenever the patient attempts a near point task. When working within the near focal points each eye will turn in and downward at an angle. The amount of time the patient may spend focusing at a near point can be lengthy. It is not unreasonable for an individual to spend up to two, three or more hours performing a task in the near point range. This time frame can complicate the symptoms of anisometropia. The image impulses collected at the fovea centralis and transmitted to the occipital lobe can not be fused into one complete image and held for any great length of time. This is due to the size disparity and spacial perception that is interpreted from each of the eyes.

The prismatic effect of off center alignment can be avoided for most single vision prescription if the patient can view all object distances with out deviating from the optical center of the lens. Inferring from Prentice Rule, if the decentration is zero then the prismatic effect will

also be zero regardless of the degree of anisometropia. For this reason the patient can be instructed to use head movements rather than eye movements when the need to deviate from a standard distance primary gaze. By learning to point his/her nose at the desired angle of view the patient can keep his/her visual axes in line with the optical center of the eye wear. This can eliminate or at least reduce the prismatic error to a tolerable level for the patient.

The reasoning for the success of this method also holds true for the anisotropic patient who selects the option of using contact lenses for his / her visual needs. As the contact lens is fit on the center of the cornea, the optical center of lens can be held in direct alignment with the patients visual axes. As the patient rotates his/ her eyes in non primary gaze positions the contact lens will move with them and thereby maintain the visual and optical center alignment

Occasionally the optician may encounter a patient who is unable to make the necessary head movements in order to alleviate the prismatic imbalances as discussed. This may be due to a muscular abnormality of the cervical muscles or when a patient has had surgery that required the fusing of the cervical portion of the spinal column. In this case the options available to the patient are contact lenses or a bicentric grind for near tasks. If the patient can not use contact lenses then the optician should determine the total vertical imbalance created by the prescribed eye wear at the near point.

To do this the optician must perform the following steps:

- ◆ Determine the total power of the lens for the vertical (90th) meridian
 - ◆ Determine the reading depth
 - ◆ Using Prentice Rule determine the prismatic effect for each lens
 - ◆ Combine the prismatic effect for both eyes to determine the total imbalance
 - ◆ Determine whether to use a standard slab off or reverse slab off design lens
-
- ◆ Determine the total power in the 90th meridian:

The total power of a given lens in the vertical position is obtained by combining the spherical component with the percentage of the cylindrical correction in effect at the 90th meridian. This can be completed by using the formula $\text{Total power} = \text{Sphere} + \text{New Cylinder}$, where New Cylinder equals the cylinder power as stated in the prescription multiplied by the Sine squared of the difference between the prescribed axis and the axis desired.

The following example illustrates how this procedure is completed.

$$\text{Rx: } +4.75 -1.00 \times 134$$

$$\text{Total Power at } 90 = \text{Sphere power} + \text{New cylinder power}$$

$$\text{New cylinder power} = \text{Cyl} \times \text{Sine squared} > \text{Difference}$$

$$\text{Sphere} = +4.75, \quad \text{Cylinder} = -1.00; > \text{Difference} = 134 (\text{Rx axis}) - 90 (\text{desired axis}) \underline{44}.$$

$$\text{Therefore: } \text{NC} = \text{Cyl} \times \text{Sine squared} > \text{Difference}$$

$$\text{Total Power at } 90 = \text{Sphere} + \text{NC}$$

$$\text{NC} = -1.00 \times \text{Sine squared of } 44$$

$$\text{T.P. at } 90 = +4.75 (+) -0.48$$

$$\text{NC} = -1.00 \times (0.69466) \text{ squared}$$

$$\underline{\text{T.P. at } 90 = +4.27}$$

$$\text{NC} = -1.00 \times 0.4825525$$

$$\text{NC} = -0.48$$

◆ Determine the reading depth:

To determine the reading depth used by the patient the optician should employ the following method. Properly adjust the frame selected for the patient's new eye wear as it will be fit at the time of delivery to the patient. With the patient sitting in a normal chair position have the patient look towards a distant object in order to stimulate normal primary gaze position. Have the patient hold a hand occluder before the left eye. Spot the vertical pupillary reflex using a pen light and marking pen on the demo lens in the selected eye glass frame. The patient should then be instructed to hold the occluder before the right eye so that the optician may repeat the marking of the left demo lens. These markings on each demo lens represent the distant visual point (DVP). In order to determine the final reading depth the optician must repeat a similar procedure to locate the near visual point (NVP).

To establish the NVP the patient should be given a reading card with a single line of print. Leave the selected eye wear on the patient after determining the DVP. Have the patient hold a hand occluder before the left eye. The optician should then place a straight edged card against the top of the non occluded side of the selected eye wear. Slowly slide the straight edged card down the eye wear until the patient reports that the line of print on the reading card disappears. Mark the point where the straight edged card has stopped on the demo lens in the selected eye wear. Repeat this procedure for the left eye. These lower markings on the demo lens represent the NVP. (Kozol, F., 1996.)

The final reading depth measurement in millimeters is derived by measuring the distance on the demo lens between the DVP and the NVP. This measurement will generally be between 6 - 10 millimeters (mm) with the average being 8 mm. (Kozol, F. 1996).

It is important to note that this measurement represents the vertical displacement of the visual axis when moving from the distance gaze position to the near point position. We have not accounted for the slight horizontal deviation encountered when the eyes converge for near point tasks. Studies have indicated that while the horizontal movement does contribute to the final prismatic effect the amount is so minimal that we can successfully assist the patient by using only the vertical decentration.

- Determine the combined prismatic imbalance:

Using Prentice Rule formula and oblique cylinder formula, if the lens has cylindrical power, the optician should calculate the prismatic effect for each eye. After the prismatic effect for each eye has been established the values must be combined to determine the total effect that will be experienced by the patient with the new eye wear prescription.

First the optician must determine the prismatic base direction. Base direction is determined by the prescription in the 90th meridian. If the total power at the 90th meridian is plus (+) then the base direction is Base Up for downward gaze. If the total power at the 90 degree meridian is minus (-) then the base direction is Base Down.

If the base direction for the two lenses are in opposite directions, (one base up the other base down), then the two prismatic effects are *added* together. If the two base directions have the same base orientation, (both base up or both base down), then the two prismatic amount are *subtracted* from each other.

For example if the prismatic effects determined were OD 2 D Base Up and OS 2 D Base Down the total imbalance would be 4 prism diopters. If, on the other hand, the prismatic amounts were OD 4 D Base Up and the OS 2 D Base Up then the total imbalance would be 2 prism diopters.

◆ Determine whether to use a standard slab off or reverse slab off design.

Once the total vertical prism imbalance has been established the optician must decide whether a standard or reverse slab off lens design should be used. If a standard slab off design is called for the optician should specify that the bicentric grind be placed on the lens with the least plus or most minus power in the 90th meridian. This is because a standard slab off lens will create a base up effect. A standard slab off design will require the surfacing lab to take a series of special steps in order to create the desired prismatic effect. This will result in a longer delivery time from the lab and can be quite expensive for the optician and ultimately the patient.

Should the optician decide to use a reverse slab off design the bicentric grind should be performed on the lens that has the most plus power or least minus power in the 90 degree meridian. This is due to the fact that a reverse slab off lens design will create a base down effect. This style of bicentric grinding is available from most lens manufacturers in a pre-molded plastic lens blank. The surfacing lab can order the desired lens blank with the molded prismatic effect on the front surface from the lens manufacture and surface the back curves to obtain the desired prescription in the same manner that they would use for a normal prescription. This can help to decrease the time, effort and frustration that can result when creating a bicentric lens. For this reason many practitioners prefer to use a reverse slab off design for their patients. Case study number one illustrates how an optician may use a slab off design for a patient.

The following case represents a patient that was determined not to be a successful candidate for a contact lenses fitting by a referring physician and therefore required a slab off (bicentric grind) for the elimination of diplopia at the near point.

Bicentric grinding for a Single vision Anisometropic patient

Case study #1:

36 year old drafts person who after an automobile accident had the third thru fifth cervical vertebra fused together limiting head movement in all directions.

Rx: OD -1.50 Sphere OS +0.75 + 2.50 x 180

ADD + 2.50 OU Reading depth 11 mm.

Applying Prentice rule for determination of individual prismatic effects at the reading depth resulted in the following :

OD - 1.50 Sphere

$P = H(cm) \times D$

$P = 1.1 \times -1.50$

$P = 1.65$ Base Down

Total vertical imbalance 1.65 BD + 2.2 BU = 3.85 prism diopters

Eye Wear made : OD -1.50 OS + 0.75 +2.50 x 180

Reverse slab of 3.75 diopters for the left lens.

OS +0.75 +2.50 x 180

$P = H(cm) \times D$

$P = 1.1 \times +2.00$

$P = 2.2$ Base Up

When the eye wear as made in case study number one was dispensed to the patient, the patient reported great pleasure when attempting a near task at the dispensing table. During a follow up visit two weeks later the patient was still enthusiastic concerning the performance of their eye wear for near tasks at home and at work. It is important to note that when the patient found it necessary to view objects with an orientation in the left, right, or upper gaze position for the distance field, she could experience some of the effects of anisometropia. This was tolerable for her as the time spent in any of these non primary gaze positions was minimal and therefore acceptable to her and she could use body turning movements to stay near the distance optical center location.

When fitting eye wear for this remedy, the optician should help the patient select an eye glass frame that is as small as possible for the customer's features and is of a symmetrical shape. This helps to eliminate the amount of lens surface that the patient has to use thereby controlling the amount of anisometric viewing. It is also advisable for the frame to be fitted with adjustable nose pads. This will allow the optician to fit the smaller circumference eye wear closer to the patient's eyes to improve the field of view created by the smaller eye wear. The adjustable nose pads can also aid in fine tuning the vertical placement of the distance optical centers.

Anisometropia presents its greatest challenge when the patient enters the presbyopic stage. As mentioned earlier in this paper, the non-presbyopic anisometric patient may be able to remedy the symptoms by becoming a "head mover" instead of an eye mover. However, when the need for a multi-focal design is warranted the patient can no longer employ this head tipping method for the near point tasks. Given this situation the optician and patient must select an option that will best suit the patient's needs. There are many options available to alleviate the diplopia effect at the near point for the presbyopic anisometropia. These methodologies include;

- 1) Bicentric grinding - Standard or Reverse slab off lenses,
- 2) Compensated or Ribbon Segments,
- 3) Dissimilar segments,
- 4) Dissimilar add powers,
- 5) Two pair of eye wear - one for distance and one for near point tasks,
- 6) Fresnel press on prisms and Contact lenses for distance viewing with prescribed reading glasses.

The advantages and disadvantages for each of the remedies listed above are summarized by the following table.

Table Number Two: Methodology Comparisons		
Methodology	Advantage	Disadvantage
<i>Standard Slab Off</i>	<i>Wide range of prismatic amounts can be created</i>	<i>Time delays in processing - Cosmetic appearance of line may be unacceptable to the patient</i>
<i>Reverse Slab Off</i>	<i>Faster & Easier to manufacture</i>	<i>As the slab is molded on the front of the lens there is limited availability</i>
<i>Compensated or Ribbon segments</i>	<i>Cosmetic appearance is more balanced than other options</i>	<i>Available in glass lens only</i>
<i>Dissimilar add powers</i>	<i>Allows same segment style for each lens</i>	<i>Can be done by the OD or MD: sacrifice Visual acuity at near point</i>
<i>Dissimilar segments</i>	<i>No special lens processing needed - cost effective for patient</i>	<i>Cosmetic appearance</i>
<i>Fresnel press on prisms</i>	<i>Lowest cost alternative for the patient</i>	<i>Cosmetic appearance, can come off the lens and be lost, visual acuity loss</i>
<i>Two pair eye wear</i>	<i>Provides least prismatic imbalance if patient is a head mover .</i>	<i>Can be costly or an inconvenience to the patient, due to constant switching pairs for specific distance to near tasks</i>
<i>Contact lenses With reading glasses</i>	<i>Provides good distance optics with out prismatic imbalance. Near point task wide field if patient is a head mover</i>	<i>Depends on patient tolerance for contact lenses.</i>

The remainder of this paper shall deal with specific case studies demonstrating the use of five of these options. Case study number two illustrates the use of Reverse slab off grinding to eliminate or at least bring to a tolerable level the dioptric effects of anisometropia.

Case Study Number Two

Rx; OD +3.50 OS -2.75 Add +2.50 Reading depth : 10 mm

1) Determine total power at 90 (vertical meridian). Do not include add power as the effect would not change the dioptric difference between the two eyes. As the lenses are spherical the total power at 90 is OD: +3.50 and OS: -2.75.

2) Determine reading depth. Following the guidelines discussed earlier. Given as 10 mm.

3) Determine prismatic effect for each eye using prentice rule:

<u>OD</u>	<u>OS</u>
$P = H(cm) \times D$	$P = H(cm) \times D$
$P = 1.0 \times +3.50$	$P = 1.0 \times -2.75$
$P = 3.50$ prism diopters BU	$P = 2.75$ prism diopters BD

4) Draw out the relationship between the two prismatic effects to illustrate the combined total. As the amounts are opposite base directions add them together. $3.50 + 2.75 = 6.25$ total imbalance base up.

<u>OD</u>	<u>OS</u>	Total Imbalance

5) Determine which eye to specify the bicentric grind:

To simplify the manufacturing process select a reverse slab of design. Therefore the Bicentric grind must be done for the eye with the strongest plus or weakest minus power in the 90 degree meridian.

OD has the strongest plus power.

6) Lenses are ordered as follows:

OD +3.50 OS -4.75 Add power +2.00 Ft - 28 Reverse slab off OD 6.25 diopters
P.D. 63/60 Seg ht 20

◆ ***Compensated Ribbon Segments***

On occasion, the standard or reverse slab off may not be the best option for the patient. This may be due to patient discomfort with the appearance of the slab off line, the cost involved in the special segment grind, or an overwhelming desire to have the eye wear crafted in a glass material choice as opposed to a CR-39 or other plastic based material. For this patient the optician may consider compensated or ribbon segments, and in some cases dissimilar segments. The philosophy behind fitting these options is to reduce the prismatic imbalance at the near point by altering the near point vertical optical center placement for each eye.

The prismatic effect of any given lens can be eliminated by aligning the visual axis of the patient with the optical center of the lens. Therefore, if the optician can manipulate the near point optical centers then he can eliminate, or at least bring to a tolerable level, the vertical prismatic imbalance experienced by an anisometric patient. An option that allows the optician to achieve this desired goal is Compensated or Ribbon segments.

Originally designed in 1932 by Jack Silverman (Fannin, T & Grosvenor, T, 1996), the ribbon segment is a lens design that is 14 mm in depth and 22 mm in width. The R-segments normal optical center, (O.C.), placement is located at the center of the segment. This results in a segment O.C. placement 7 mm below the top of the segment line.

By regrinding the front surface of this lens design, the segment depth can be altered this in turn allows affects the O.C. placement. This allows the O.C. to be placed from 4 mm below the top segment line to 10 mm below the top segment line as designated by the optician. The result is a series of seven lenses available from the manufacture which is denoted by the letter R and the segments O.C. placement. For example, a segment with an O.C. placement 4 mm below the top segment line is designated as a R-4, a segment with an O.C. placement 5 mm below the top segment line is designated as a R-5.

By fitting a different R-segment for each lens of the anisometropic patient's eye wear the optician can either totally eliminate the prismatic effect or at least reduce the prismatic effect to a tolerable level for the patient. To determine which R-segment to fit for each lens the optician must complete the following steps. First, the optician must determine the vertical prismatic imbalance experienced by the patient. This is achieved in the same manner as presented in the section concerning slab off lens designs. Once the total vertical prismatic effect is determined the optician divides this amount by the prescribed add power. The value obtained represents the needed separation between the segments optical center placement in centimeters. This value must then be converted to millimeters.

After determining the required separation between near point O.C.'s the optician then selects the two R- segments that will result in the determined O.C. placement separation. For proper placement of the two lenses selected, the R-segment with the O.C. located the greatest distance from the top of the segment is placed before the eye with the most plus or least minus in the vertical meridian (Fannin, et. al., 1996). For example, if a particular anisometropic patient required a R-4 and a R-10 lens selection the R-10 lens would be used for the eye that had the most plus or least minus power in the vertical meridian. Case study number three illustrates how an optician may fit a patient with the ribbon segment lens design.

Case study Number three:

OD -0.75 sphere OS +0.50 +1.00 x 45 +3.50 Add OU *reading depth 12 mm*

1) *Determine vertical prismatic imbalance:*

Determine total power at 90 for each eye, apply prentice rule and then calculate imbalance

OD

OS

a) $T.P. 90 = -0.75$

$T.P. 90 = \text{Sphere} + \text{Cylinder effect at } 90$

$T.P. 90 = +0.50 + (\frac{1}{2})(+1.00)$

$T.P. 90 = +0.50 + 0.50 = +1.00$

b) $P = H(\text{cm}) \times D$

$P = H(\text{cm}) \times D$

$P = 1.2 \times -0.75$

$P = 1.2 \times +1.00$

$P = 0.9$ prism diopters BD

$P = 1.2$ prism diopters BU

c) *Since the prismatic base effects are in opposite direction combine amounts together*

$0.9 + 1.2 = 2.1$

2) *Determine the separation between segment optical centers*

Divide the Prismatic imbalance by the add power

$2.1 / 3.50 = 0.6 \text{ cm or } 6.0 \text{ mm at the reading depth.}$

3) *Select R- segment combination that will match segment O.C. separation.*

6 separation requires a R-4 and an R-10 Segment

4) *Determine which eye receives which segment style*

Place the lens with the greatest O.C. distance before the eye with the most plus or least minus

Right eye = R-4

Left eye = R-10

5) *Order lenses as follows*

OD -4.75 OS +2.50 +1.00 x 45 +2.50 Add OU, R-4 OD & R-10 OS

◆ *Dissimilar segments*

Should the optician wish to use dissimilar segments to correct for vertical imbalance they would use the same procedural format established for ribbon segments. In this method the optician will use normal bifocal segments styles such as Flat Top, Round, Executive, Hemis-spheric, and Curve top. By using one bifocal style in the right eye lens and a different style in the left lens the optician can achieve the desired segment optical center separation. Table number 2 illustrates the optical center placement for these segment styles in both CR-39 and glass.

Table Number Three:

<i>Segment Style</i>	<i>Segment Dimensions</i>	<i>Optical Center Placement</i>
<i>Flat top (D seg)</i>	<i>22.25.28.35.45.</i>	<i>5 mm Below segment top - note some 45 can be had with the OC on the line</i>
<i>Round (Kryptoc)</i>	<i>22,24,25,28</i>	<i>Center of segment</i>
<i>Executive</i>		<i>On Segment line</i>
<i>Hemis-spheric</i>	<i>38 & 40</i>	<i>At bottom of segment</i>
<i>Curve Top</i>	<i>25,28,40</i>	<i>5.0 mm Below segment top</i>

The procedural format to determine what segment style to use for each lens in the finished eye wear follows the same steps used in Ribbon segment selection. Case study number four represents an example of dissimilar segment fitting for an anisometric patient.

Case study number four

Rx: OD + 2.75 OS +1.5 Reading depth 9 mm +2.00 Add OU

Determine total power at 90, Apply prentice rule, Divide answer by add power, determine lens styles to achieve O.C. separation.

1) Determine the Total Power at 90

OD +2.75 OS +1.50

2) Apply Prentice Rule

OD

OS

$$\begin{aligned} P &= H(\text{cm}) \times D \\ P &= 0.9 \times 2.75 \\ P &= 2.48 \text{ BU} \end{aligned}$$

$$\begin{aligned} P &= H(\text{cm}) \times D \\ P &= 0.9 \times 1.50 \\ P &= 1.35 \text{ BU} \end{aligned}$$

Imbalance: $2.48 - 1.35 = 1.13$ (subtract due to same base directions)

3) Divide vertical imbalance by add power

$1.13 / 2.00 = 0.565 \text{ cm}$ So select lenses with a 6.64 mm separation between O.C. location.

4) Consult chart number

Select a Ft 35 and a FT - 45 oc on line. This gives a 1.64 mm difference remaining in O.C. placement. This reduces the prismatic effect to tolerable level. When faced with this decision it is best to slightly under correct.

5) Determine seg placement in final eye wear.

Segment with the lowest O.C. placement from the top line before the eye with the Strongest plus power.

Therefore OD = FT 35 OS = FT - 45 seg oc on line

* Note one could select Ft -45 on OD & FT - 45 seg oc on line for OS

Ft 45 on OD & Executive on OS and obtain same corrective result - select for cosmetics.

◆ *Dissimilar Add Powers*

As mentioned earlier the total prismatic effect experienced by a patient at the near point dependant on two factors. These two factors are the total power in the 90 meridian at the near point and the reading depth, or decentration of the eye from the distance visual point to the near visual point. We therefore can control the prismatic effect by manipulating either of these two factors.

In two of the case studies previously mentioned the prismatic effect was either eliminated or reduced to a tolerable level for the patient by manipulating decentration. The creation of a separation between the patients vertical near point position and the optical center location of the segment will counter the vertical imbalance effects.

The prismatic imbalance effect in the finished eye wear for an anisometric patient can be decreased by manipulating the second variable total power at the near point. This can be achieved by adjusting the add powers so that the difference in the dioptric power reduces the prismatic effect. It is important to note that this is an option that can not be performed by the optician alone. Manipulation of add powers falls under the scope of practice of the optometrists or ophthalmologists.

A close working relationship between the optician and referring physician may make the option of dissimilar add powers a potential corrective action. This option will generally be met by the referring physician with great reservation. The physician would have to sacrifice the visual acuity of the patient at the near point in order to employ this option. This puts the patient and the physician in a position of having to determine which is more important to the patient, best correctable visual acuity at near or the diplopia effect created by the anisometropic condition. As the diplopia can be alleviated by other means most physicians will not prescribe dissimilar add powers.

◆ *Fresnel Press on Prisms.*

Based on the principles of the French engineer and physicist Augustine Fresnel, this option was first made available by Optical Science in the early 1970's. These press on prisms are made in small sheet forms and are available in a wide range of dioptric power. Due to the sheet form, Fresnel press ons can be cut to fit virtually any finished lens shape.

The procedures for using a Fresnel press on for an anisometropic patient are very simple. The optician would first manufacture the lenses as called for on the lab job ticket. No special calculations or formulas have to be completed at this point. Once the lenses have been properly manufactured and mounted into the frame the optician calculates the vertical imbalance created at the near point due to the anisometropic condition.

After deriving the total dioptric imbalance the optician would select the Fresnel prism blank that would counter act the imbalance. If, for example, the total dioptric imbalance was determined to be 4.0 prism diopters the optician would select a 4 diopter Fresnel press on prism blank. The optician would then determine which eye to apply the Fresnel prism to. Since the base direction of a press on prism can be orientated at the opticians discretion there is no rule as to which lens the prism wafer should be attached to. The optician must ensure that the direction of the base is placed in a fashion that will offset the total vertical imbalance.

After establishing which eye that the wafer will be applied to and the base direction orientation, the prism wafer is cut to conform to the shape of the selected lens. The wafer should then be trimmed to fit over the lower portion of the lens to coincide with the location of the multi- focal segment. If desired, the wafer can be trimmed to fit within the confines of the multi- focal segments shape.

The wafer is then attached to the back surface of the lens under running water. After drying, the Fresnel press on wafer will be highly adhered to the lens back surface. The patient should then be instructed how to clean and care for the wafer attachment. Instructions should include what the patient should do if the wafer separates from the lens.

While this option presents a low cost alternative for the patient, there are some disadvantages to employing this method of vertical imbalance correction. These disadvantages

include loss of visual acuity due to distortion and chromatic aberration (Adams, A.J., Kapash, R.J. & Barkan, E 1971), loss of contrast sensitivity, potential loss, and cosmetic appearance of the grooves. Therefore, it is recommended that this option be employed as a temporary action. This could allow the patient relief while the final eye glasses are being made or as a trial to determine if the diplopia effects can be eliminated to a tolerable level.

The final two options that an optician can use to assist the anisometropic patient are two pair of eye wear - one pair for distance and one for near, or contact lenses. When employing the use of contact lenses the patient can be fit with one of two methodologies. One approach is to fit the contact lenses for distance use and eyeglasses for near point tasks. Another approach is to mono fit one eye with a contact lens for distance viewing and one eye with a contact lens for near point tasks. As the methodologies of fitting contact lenses for the anisometropic patient have many advantages and disadvantages a discussion on these effects is beyond the intended scope of this paper. It is important to understand that contact lenses do offer an alternative for the anisometropic patient and if the optician is involved with fitting contact lenses he / she may wish to have the patient evaluated for this treatment option.

It becomes apparent, after reviewing each of the methods outlined in this paper, that the optician has many options that they may present to the patient for alleviating or at least reducing to a tolerable level vertical imbalance. These methods have been presented in their simplest fashion to aid understanding and encourage the usage of the methodologies. Even in this manner they can be time consuming and difficult to perform. However if an optician wishes to practice their craft to the highest possible professional level and provide the best optical care for their patient the time is well spent.

Success with any of the methods presented will come only when the optician engages in an active conversation with the patient. This means that the optician must be able to listen to the patients visual symptoms and desires. By asking probing questions and listening carefully to the responses an optician may present the best possible options for the patient. This will allow the patient and the optician to select the best course of action.

With this approach the professional optician will avoid placing the patient through a highly frustrating experience thereby making life better for everyone.

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