Vertically Challenged Part 2

[1 CE CREDIT]

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Part 2 (visit Part 1 at 2020mag.com/CE) continues the discussion and explores a third option to correct for vertical imbalance: slab-off. It also covers how to calculate power in oblique meridians and demonstrate the use of the power cross when calculating vertical imbalance.

SLAB-OFF / REVERSE SLAB-OFF/ BI-CENTRIC GRINDING

The most common way of correcting vertical imbalance is to induce a vertical prismatic effect in the lower half of one lens. This type of correction is referred to as bi-centric grinding or slab-off. It can be used to correct for imbalance amounts ranging from 1.5D to 6D. Slab-off provides base up (BU) prism and is applied to the most minus, or least plus lens in the vertical meridian to offset excessive base down (BD) induced by the opposite lens. Slab-off can be incorporated into either a glass or plastic lens, although each is manufactured in a different way. The main difference is that a glass lens has the slab-off ground on the front surface since the bifocal is fused into the lens, and a plastic lens has it ground on the back surface due to the presence of the molded bifocal segment on the front.

Reverse slab-off lenses are molded, or cast with base down prism in the lower segment area, rather than having base up prism generated using bi-centric grinding. The advantage here is that reverse slab-off lenses can be kept in inventory by the lab as semi-finished lenses facilitating normal surfacing techniques, resulting in faster delivery time. Because reverse slab-off provides BD prism instead of BU, it is always used on the most plus or least minus lens in the vertical meridian to offset excessive BU induced by its partner.

In a situation where large amounts of vertical imbalance are present, for example, greater than 6D, consider using slab-off for one eye and reverse slab for the other.

RECOMMENDED STEPS FOR ORDERING

Calculate how much vertical imbalance is induced by the distance lenses and determine if it will create visual

LEARNING OBJECTIVES:

Upon completion of this program, the participant should be able to:

1. Have a knowledge and understanding of slab-off/reverse slab-off, its use in correcting for vertical imbalance and how it is verified.
2. Use a power cross to determine meridian powers.
3. Determine meridian powers when dealing with oblique axes.

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After completing a three-year apprenticeship and successfully passing the Washington State Boards, he became a LDO in 2005. He received his Master in Ophthalmic Optics in June 2009 and is currently the optical manager for a private optometric practice in Battle Ground, Wash. He holds multiple black belt degrees in Tae Kwon Do, which he also teaches on a part-time basis.

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discomfort for the patient.

Using Table 1, apply slab-off or reverse slab to the appropriate lens.

Order the slab line placement at the appropriate position based on the multifocal style being used as indicated in Table 2.

Occasionally, the prescribing doctor will indicate the need for slab off. However, the optician must always be on the alert for its need since ultimately it is the optician's responsibility.

TABLE 1: LENS SELECTION FOR SLAB-OFF/ REVERSE SLAB

Lens Combination	When Using Slab-off	When Using Reverse Slab
Two minus lenses	Highest minus	Lowest minus
Two plus lenses	Lowest plus	Highest plus
One plus, one minus	The minus lens	The plus lens

TABLE 2: PLACEMENT OF THE SLAB LINE

Multifocal Style	Slab Placement
Flat top bifocal	Slab line should be in line with the top of the bifocal
Trifocals	Slab line should be in line with the bottom of the intermediate portion
Progressives	Slab line should be positioned slightly above the near verification circle

LENS DETERMINATION FOR SLAB-OFF/REVERSE SLAB

The following table illustrates on which lens to place the slab-off/reverse slab depending on the lens combination being utilized. A simple way to remember the rule is to visualize the slab for what it is and what it provides to the optical system:

Slab-off provides base up prism so it will always be applied to the lower part of the lens that is naturally inducing the most base down, or least base up prism when viewing through a position below the distance OC. Hence, the most minus or least plus.

Conversely, reverse slab provides base down prism so it will always be applied to the lower part of the lens that is naturally inducing the most base up or least base down prism when viewing through a position below the distance OC. Therefore, the most plus or least minus.

It should be noted that although slab-off can be used on any lens, cosmetically it works best on a flat top bifocal due to the slab line forming a continuation of the top of the segment. In addition, the wider the bifocal used, the less noticeable the slab line will be.

Note: When working with a progressive lens, your lab can often offer the best recommendation for the location of the slab placement depending on the progressive being used. Some patients wearing progressive lenses will experience less vertical imbalance than with a lined multifocal due to the moving optical center in a progressive from distance to near. For this reason, it may not always be necessary to correct for moderate amounts of vertical imbalance.

THE SLAB-OFF MANUFACTURING PROCESS

(Modified from "Clinical Optics" by Fannin and Grosvenor)

A slab-off lens is made using a procedure called bi-centric grinding. After the front surface of the lens is finished in the usual manner, a dummy or cover lens manufactured to match the base curve of the required lens is then cemented onto the front surface. The front surface is then reground using the tool originally used for that surface, but ground in a way that the dummy is ground away in the upper portion while leaving it attached to the lower portion. The back surface is then finished with the remaining dummy considered as an integral part of the blank. The blank is now an equal thickness at the top and bottom unless the prescription calls for prism in the distance. When the lens is finished, the remaining dummy on the lower portion is removed. The dummy is base down prism resulting in the addition of base up prism in the lower portion of the lens.

This procedure also results in an upward displacement of the center of curvature of the front surface of the lens in the lower portion, resulting in the front surface having two centers of curvature, one for the upper portion and for the lower, but both having the same curvature. This produces a unique optical axis for each of the two portions of the lens.

Bi-centric grinding can be done on either the front surface in the case of a fused lens such as a glass flat top bifocal, or on the back surface in the case of a lens where the multifocal segment results in a wedge on the front surface such as a plastic bifocal.

EVALUATING FOR VERTICAL IMBALANCE IN A SPHERO-CYLINDER LENS

Determining lens power in the vertical meridian of a spherical lens is very straightforward since it is the same in

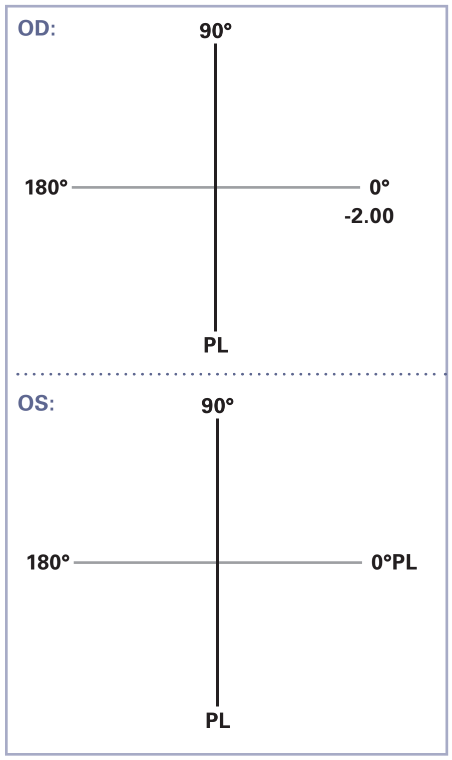
both meridians. However, with a sphero-cylinder lens, this is not the case; the sphere and cylinder powers are ground at 90 degrees to one another. All the cylinder power is effective at 90 degrees to the cylinder axis, and only the sphere power is effective along the cylinder axis. When evaluating for lateral or horizontal prism, the effective power in the horizontal or 180-degree meridian is the one to use for calculation purposes. When determining vertical prism or vertical imbalance, the effective power in the vertical or 90-degree meridian is the one to be considered. The following examples will demonstrate how to calculate vertical imbalance when presented with a variety of different prescriptions.

Example 1:
OD: PL -2.00 x 090 ADD +2.50
OD: PL SPH ADD +2.50

At first glance, the prescription for both eyes appears notably different. Assuming this prescription would need correcting for vertical imbalance based on the numbers alone would be an easy mistake to make. However, before jumping to any conclusions, it is important to closely dissect the prescriptions. The simplest way to do this is using a power cross. A power cross is used to illustrate the effective power in each meridian separated by 90 degrees. It is beneficial for the optician to become familiar with using a power cross since the process is also used when determining vertexed power modifications with toric contact lenses.

Remember, for vertical imbalance we are concerned only with the lens power in the vertical or 90-degree meridian. Also, remember all the cylinder power is present in a lens at 90 degrees to the axis, and only the sphere power is effective along the meridian in line with the cylinder axis.

For the right eye, the axis is 090 so all the cylinder power is present in the horizontal or 180-degree meridian. In the vertical or 90-degree meridian, the total power is plano. For the left eye, the lens is plano in both horizontal and vertical meridians. Let's plot this out:



The effective power in the vertical meridians for both eyes is plano. Therefore, regardless of the reading position, because there is effectively no power in the vertical meridian, using the Prentice rule, we can determine there will be no induced prism and consequently no vertical imbalance at the reading level in this scenario.

Example 2:
OD: +2.50 – 1.00 x 045 ADD +2.00
OS: +4.00 – 0.50 x 180 ADD +2.00

Once again, let's transfer the numbers to a power cross to aid with visualization:

The right eye is a little more complex due to the oblique axis. The table below illustrates how to compute power in the

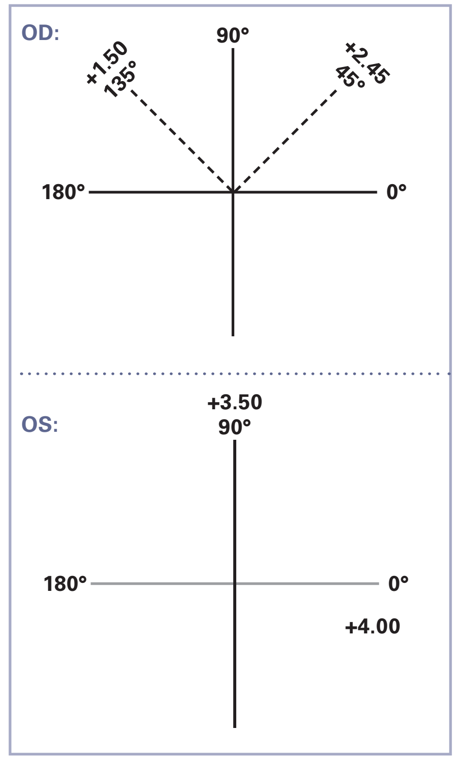


TABLE 3: DETERMINING LENS POWER IN OBLIQUE MERIDIANS

A cylinder has:

- **100% of its power 90 degrees from its axis**
- **75% of its power 60 degrees from its axis**
- **50% of its power 45 degrees from its axis**
- **25% of its power 30 degrees from its axis**
- **0% of its power on axis**

Optical Formulas Tutorial, Stoner & Perkins

horizontal and vertical meridian when dealing with oblique axes.

This can often be a source of confusion, so here's a simplified way to view it. It can be seen that axis 45 is halfway between the horizontal and vertical meridian. If 100 percent of the cylinder power is present 90 degrees from the cylinder axis, it stands to reason that 50 percent of the cylinder power is present 45 degrees from the cylinder axis. Thus, in this case, in both the horizontal and vertical meridian, 50 percent of the cylinder power is present. Therefore, the power in the vertical meridian for the right eye is: +2.50 plus (50 percent of -1.00) = +2.00/. And the power in the vertical meridian for the left eye is: +4.00 plus (100% of -0.50) = +3.50.

Now, consider a reading position 10 mm below the OC. Induced prismatic effect can again be calculated using the Prentice rule:

Prism = Distance from OC (cm)
x Lens Power

OD: = 1 x +2.00 = 2D and the direction is BU *(Because the lens is "+")*

OS: = 1 x +3.50 = 3.5D and the direction is BU *(Because the lens is "+")*

Both lenses are base up which results in 1.5D of vertical imbalance (the difference between the two). The lenses are both plus, and slab-off is always applied to the most minus or least plus lens. Therefore, this can easily be neutralized by using 1.5D slab-off on the right lens. 1.5D reverse slab could just have easily been used on the left lens.

What if the cylinder axis differs from those included in the table? The cylinder axis almost always falls somewhere between the listed values. In such cases approximations are accurate enough for evaluation purposes. Let's explore how to approximate.

Approximation Example:
Presented with the following prescription, the objective is to determine the effective power in the 90-degree meridian.

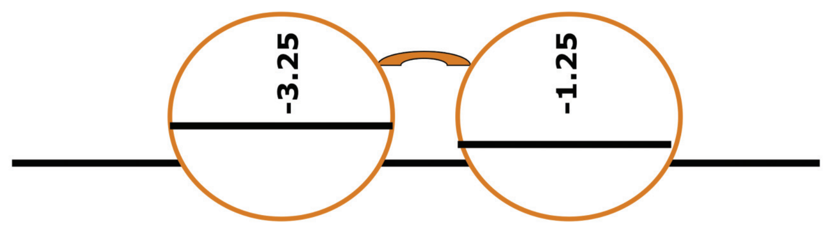
- •Rx: -1.50 -1.00 x 050
- •Axis is 40 degrees from the vertical, or 90-degree meridian.

Based on the above table, approximately 45 percent of the cylinder power is effective in the 90-degree meridian = -0.45D which can be rounded to -0.50D.

Therefore, the approximate effective power in the 90-degree/vertical meridian = -2.00D.

Using this approximation technique provides a relatively efficient way to determine if vertical prism might present itself as a problem. With some practice, this will become second nature and a very useful tool for the optician.

VERTICAL IMBALANCE



The Rx: R -1.25 – 2.00 x 180 and L -1.25 sphere produces vertical imbalance when looking through the lower portion of the lenses (the line). If in a bifocal or progressive, the results (above) can create double vision for the wearer. Consider whether the patient can tolerate the imbalance or slab-off is indicated.

VERIFICATION OF SLAB-OFF

There are two basic ways to verify slab-off:

1. Comparing the vertical prismatic effects of the two lenses through a lensometer and checking for actual image displacement at the reading level. The amount of the slab-off is the difference between the calculated amount of vertical imbalance and the amount found using lensometry. ("Clinical Optics," Fannin and Grosvenor)

For Example:
- •Calculated vertical amount from the Rx = 3D
- •Image displacement at near point observed using lensometry = 1D
- •Slab-off prism applied = 3 – 1 = 2D

2. Using a lens clock is a much easier method. First, position the lens clock horizontally across the lens center in the distance portion paralleling the slab line and record this base curve. Second, rotate the lens clock through 90 degrees with the pins perpendicular to the slab line with the central pin directly on the line and record this base curve. The difference between these two base curves indicates the amount of slab-off prism applied.

The goal of this discussion is to help dispel the belief that dealing with such topics is overwhelming and intimidating. Using tools such as the power cross and being able to visualize lens meridian powers can significantly simplify matters. Having knowledge of the techniques and options covered in this program empowers the optician to confidently handle complex prescriptions such as those presented here and provide the patient with superior eyecare. Our role as eyecare professionals involves using our skills and knowledge to predict the outcome of the written prescription so there are no surprises. It is our responsibility to complete the eyecare chain by "filling" the written prescription, watching for any foreseeable complications and intercepting them with preventative measures. Only by doing so, we can provide our patients with the best and most comfortable vision possible. ■

SELF-ASSESSMENT EXAMINATION

1. One of the most common ways of correcting for vertical imbalance is:
- a. Inducing a vertical prismatic effect in the upper half of one lens
- b. Slab-off
- c. Grinding base in prism to both lenses
- d. Using a flat top bifocal

2. BU Slab-off prism:
- a. Is applied to the most plus or least minus lens
- b. Incorporates BD prism
- c. Can only be applied to a glass lens
- d. Is applied to the most minus or least plus lens

3. The main difference between slab-off on a glass lens compared to a plastic lens is:
- a. BU in glass and BD in plastic
- b. In glass on the front surface, on back in plastic
- c. Only reverse slab-off on plastic
- d. A and B

4. Bi-centric grinding:
- a. Isn't something for the optician to be concerned with
- b. Can only be applied to a FT bifocal
- c. Is placed at the bottom of the intermediate on a trifocal
- d. Is a pre-cast plastic, bifocal molded onto the front surface

5. Slab-off can be used to correct for:
- a. Horizontal displacement of the OC
- b. C and D
- c. Imbalance from 1.5D to 6D
- d. Vertical Imbalance

6. The bi-centric grinding process:
- a. Makes a reverse slab-off
- b. Results in an upward displacement of the center of front curvature
- c. Can be done on either the front or back
- d. b and c

7. When considering ordering slab-off:
- a. The optician can always rely on the lab to add it to the order when necessary
- b. First determine if it will create visual discomfort for the patient
- c. If in doubt, always order to increase the average sell price
- d. The doctor is the only one that can order slab-off

8. When determining oblique power:
- a. 100 percent of cylinder is at the axis
- b. 50 percent of cylinder is at the axis
- c. 100 percent of cylinder is 90 degrees from its axis
- d. B and C

9. Reverse slab-off:
- a. Takes much longer to manufacture
- b. Provides base up prism
- c. Is the same as bi-centric grinding
- d. Is always applied to the most plus or least minus lens

10. A "dummy" lens:
- a. Is cemented to the front surface of a lens
- b. A and C
- c. Is also called a cover lens
- d. Is cemented to the back surface of a lens

11. A power cross:
- a. Measures base curves
- b. Is only used when calculating vertical imbalance and has no other uses
- c. Illustrates the effective meridian power
- d. Is the progressive fitting cross

12. Vertical imbalance:
- a. Is determined by the vertical prism for each eye
- b. May cause visual discomfort for binocular patients
- c. Can't be corrected
- d. A and B

13. For Rx: +3.00 -2.00 x 030, what is the effective power in the vertical meridian?
- a. -1.50D
- b. +1.00D
- c. +1.50D
- d. +2.50D

14. For Rx: -12.00 -3.00 x 045, what is the effective power in the vertical meridian?
- a. -10.50D
- b. -13.50D
- c. -12.00D
- d. -15.00D

15. How much vertical prism would be present through a FT28 whose OC is 5 mm below the seg top at a reading level of 10 mm below the distance OC with the following Rx: +3.50 -3.50 x 180 Add +2.50?
- a. 3.5D
- b. Zero
- c. 35D
- d. 0.35D

16. Estimate the vertical power for Rx: -3.00 -3.00 x 057.
- a. -6.00D
- b. -3.75D
- c. -5.00D
- d. Plano

17. Estimate the vertical power for Rx: +2.00 -4.00 x 050.
- a. +0.50D
- b. -1.25D
- c. -2.00D
- d. +2.00D

18. When verifying slab-off:
- a. The radiuscope is most accurate
- b. A lensometer can be used
- c. B and D
- d. A lens clock can be used

19. When verifying slab-off using a lensometer:
- a. Calculate the difference between the vertical imbalance observed through the reading level
- b. Simply observe the difference in image displacement at the reading level
- c. Slab-off cannot be verified using a lensometer
- d. Measure how much base in prism in each lens

20. When verifying slab-off using a lens clock:
- a. First, measure the base curve of the upper distance portion of the lens
- b. Second, position the lens clock vertically with the center pin on the slab line
- c. Third, measure the base curve of the back surface of the lens
- d. A and B

Examination Answer Sheet

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Vertically Challenged Part 2

Directions: Select one answer for each question in the exam and completely darken the appropriate circle. A minimum score of 80% is required to obtain a certificate.

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1.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
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10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	20.	Ⓐ	Ⓑ	Ⓒ	Ⓓ

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