# What if the vertex is different?

In our continuing series looking at the use of calculations in dispensing, **Janet Carlton** this month considers the importance of vertex distance on refraction

IDEALLY, THE LENS should sit in the chosen spectacle frame in exactly the same position as in the trial frame during refraction. If this is not the case, the way the lens behaves (and consequently the patient's visual comfort) may not be as the optometrist intended. The main concern is that the lens may be sitting closer or farther from the eye, effectively altering the power of the lens. Failure to take into account any difference between the dispensed and the trial frame back vertex distances (BVDs) will result in an incorrect final lens power.

The vertex distance needs to be measured for all prescriptions over +/-5 D. If you choose to calculate the compensated power using a formula, you must know if the new power is expected to be more positive or more negative, and change the calculation as necessary. Errors here would be easy to miss.

## REMEMBER

Move a lens away from the eye, it becomes more positive, so it needs to be made more negative, and of course vice versa.

There is a vertex measuring set which measures from the lid to the back plane of the spectacles, but sadly does not take into account the lid thickness. Measuring by eye is difficult, as the back plane of the lens is likely to be hidden. With standard metal frames (with dummy lenses) the back plane of the lens is likely to be coincident with the front surface of the empty frame (Figure 1). This method is often more accurate than a measuring device.

## POWER CHANGE

We now need to look at the various ways to change the lens power. By far the easiest way is to use lens tables. These tables may be limited in either the power range they address or the millimetre steps used.

There are some softwear programs that will do this for you, for example http://pocketsoft.co.uk/ but using Excel it's easy to create your own set of tables.

The Excel sheet in Figure 2 will create a table of values for minus lenses. To alter this for plus lenses, replace the starting minus value with a positive one and swap the labels 'farther' and 'closer'.

Values in the red cells need to be entered; yellow/green/pink/blue cells can be cut and pasted. This will produce the Excel table in Figure 3.

There may be occasions when the power is below 5D and the vertex is increased significantly, as in the case of a diving mask, where you may still need to change the power of the lens.

As a rule of thumb you need to change the power of the lens if the following relationship between power and vertex change is met.

$F^2$ x d >250 (derived from above table where for every millimetre of change the power alters by $F^2/1000$ and d is the change in vertex values.)

## Example 1

1D lens moved by 25mm
$1^2$ x 25 = 25mm (No need to change).

## Example 2

10D lens moved by 3mm
$10^2$ x 3 = 300mm (Need to change).

Care should be taken if the patient has a high-powered toric lens and there is a vertex change. Always transpose into cross cylinder form before you work out the compensated powers. The Pocket soft program really comes into its own here as it deals with cylinders for you.

By far the easiest method and least prone to error is to ray trace (Figures 4 and 5).

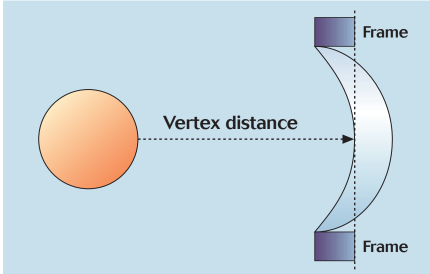


FIGURE 1. Use the front of the frame as a reference point

## Example 3

Lens power of +9.00DS with a vertex longer by 3.5mm

- ◆ Step 1: 1/F= f` 1/9 = 111mm
- ◆ Step 2: f+d 111 + 3.5 =114.5mm
- ◆ Step 3: 1/f = F` 1/114.5 =+8.73D, Order **+8.75D**.

## Example 4

Lens power of +9.00DS with a vertex shorter by 3.5mm

- ◆ Step 1 1/F= f` 1/9 = 111mm
- ◆ Step 2 f+d 111 - 3.5 =107.5mm
- ◆ Step 3 1/f =F` 1/107.5 =+9.3D, Order **+9.25D**.

For a minus lens, see Figure 5.

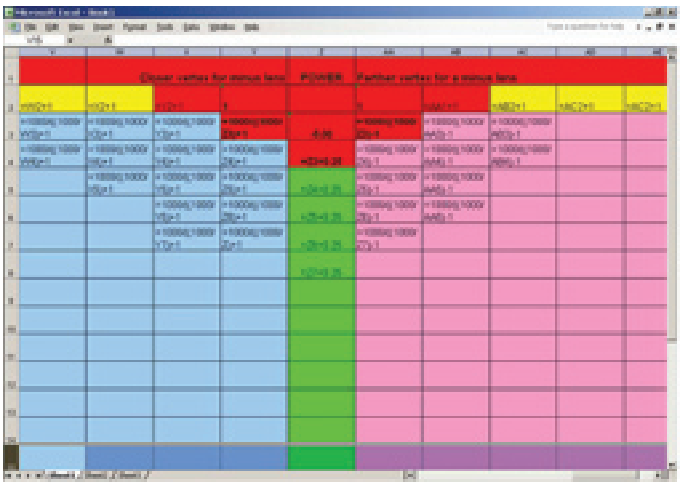


FIGURE 2. A table of values for minus lenses

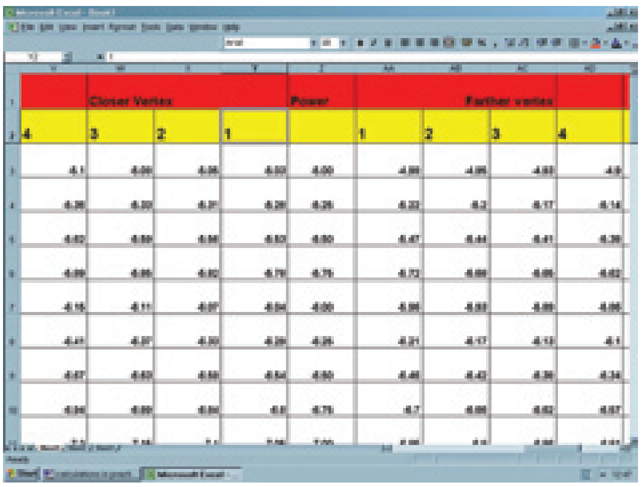


FIGURE 3. Calculated power values

### Example 5
Lens power of -10.00DS with a vertex longer by 3.5mm

Step 1: 1/F=f` 1/10 = 100mm
Step 2: f+d 100 - 3.5 =96.5mm
Step 3: 1/f =F` 1/96.5 = -10.36D,
Order **-10.25D**.

### Example 6
Lens power of +10.00DS with a vertex shorter by 3.5mm

Step 1 1/F=f` 1/10 = 100mm
Step 2 f+d 100 + 3.5 = 103.5mm
Step 3 1/f =F` 1/103.5 = -9.66D,
Order **-9.50D**.

Ideally, for every prescription you should ensure that the back vertex distance, along with the angle of side and the centration are accurate. We have already looked at the potential problems with poor centration, and should also consider problems due to the angling of the frame.

Because most trial frames have no pantoscopic angle, when the lens is glazed to a frame with an angle of side (most frames), a cylindrical element may be induced in the lens. This is a particular issue in high base curve lenses where the lenses are angled more acutely in the horizontal meridian.

Due to the popularity of frames that sweep around the face, you need to be aware that there will be some unwanted cylinder induced by the large horizontal dihedral angle (Figure 6)

It is possible to calculate the value of this unwanted cylinder and then work equal and opposite cylinder on the lens so that in 'the worn' position the patient is looking through the required Rx. This compensation is done on all high base lenses designed for wraparound frames. (and an increasing number of progressives).

When the compensation has been made, the power read on the focimeter will be the compensated power, which you should find written on the lens envelope. Companies that make this type of high-base lens (Essilor's Openview, for example) will publish a list of frames that they know will be suitable for that lens. Do not try to dispense this lens to a different frame as the induced cylinder may be intolerable for your patient.

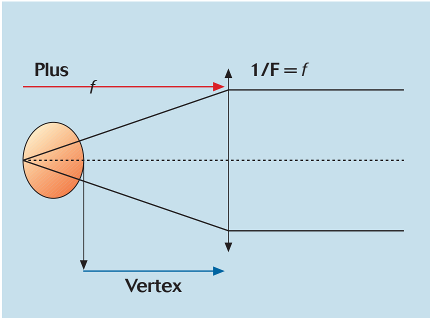


FIGURE 4. Plus lens

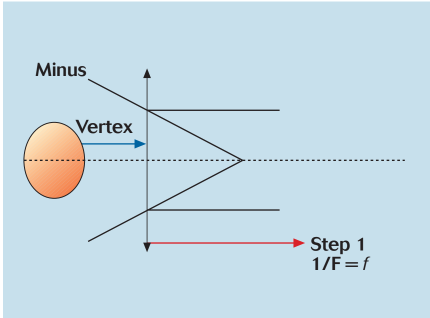


FIGURE 5. Minus lens

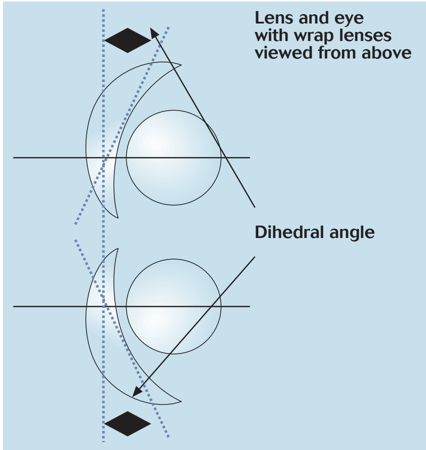


FIGURE 6. Dihedral angle

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