Basic optics and lenses

Video 1 Introduction

Basic opticianry will cover a number of different subjects. Our first series covers eye anatomy, refractive errors and beginning lenses. We will cover lens styles, materials, and beginning fitting of each lens. I have tried to make it simple for someone that has little or no prior knowledge in the field but also to extend it beyond the basics so everybody should gain something from the video series.

Video 4 Beginning lenses

This video covers the very basics of lenses starting with single vision to multifocal. The first lenses that will be covered are single vision lenses to correct hyperopia and myopia.

A hyperopic patient will need a plus lens to correct the problem. This is just like a magnifier so as a person looks through the lens images will look larger. A plus lens will also be thicker in the middle and thinner on the edge. This is a side view of a basic plus lens.

A myopic patient will need a minus lens to see in the distance well. This type of lens will minify an image as a person looks through it. It will be thinner in the middle and thicker on the edges. Here is a side view of a typical minus lens.

As you have probably gathered there are plus and minus lenses in the optical industry. The lenses are measured in diopters; the diopter is the basis of measuring a lens, the greater the number, the greater the power, starting at zero and going both in plus powers and minus powers. In the plus range the power starts at a +.25 and goes up in quarters to more than +16.00. So a typical lens could be a +2.25 or +6.50 as an example. Minus lenses will be the same except for the sign will be a minus. As an example the power could be a -5.75 or -2.50. The power in a minus lens could also exceed -25.00.

The next refractive error to go over is astigmatism. The cornea should be a sphere shape similar to a basketball. If the cornea is misshapen it will be more like a football with a long curve in one direction and a shorter curve perpendicular to the first curve. The lens that corrects this will have two distinct curves and is called a compound lens. The second
curve is a cylinder curve combined with the sphere curve. When an RX is written for astigmatism it will have two powers and a third number to indicate axis. As a sample an RX will look like this. -1.00 -1.00 X 132. With this second curve the axis has been introduced and will be from 1 to 180.

The axis is a reference to the sphere power of the lens. The 180 line is the horizontal line across the eye. The axis then starts at 1 on the right of the eye as if you are looking at a patient, continuing an arc from right to left. Axis 90 will be the vertical line perpendicular to the 180 and 45 will be on the right side between the 90 and the 180 lines. Axis 135 will be on the left side halfway between the 90 and 180 lines. Please refer to the diagram to see the position of the axis.

The last refractive error covered in the video is presbyopia. This is a condition that happens to all people over 40. The time it happens to a person can vary from late thirties to the late 40’s and sometimes the 50’s. The crystalline lens in the eye becomes less elastic and a person cannot focus up close without corrective lenses. In most cases a patient will need a multifocal lens to correct the problem but some people can just use reading glasses. A multifocal lens is a lens with a distance RX and an ‘add’ at the bottom of the lens to focus up close. This add is a plus power that ranges from a +1.00 to a +3.00 depending on the age of the patient. The add can be as low as a +.50 and be higher than a +3.00 but in most cases it will have the +1.00 to +3.00 range. The add can be a visible segment of power, called a bifocal or trifocal, or a lens that has the power added gradually across the lens called a progressive.

When a doctor prescribes a multifocal lens and a specific add it will usually focus at a specified reading level such as 16 inches. Depending on the age of the patient the add will change so he or she can read at 16 inches. The older the patient the more power is needed to see at the reading level. So a 45 year old patient may need a 1.50 add and a 55 year old patient may need a 2.50 add. The doctor can also change the power of the add to focus at specific distances like a computer screen or arms length.

Terms to remember
- **Minus lenses**: Lenses made to compensate for near sightedness. This lens will diverge light rays or images. It is thinner in the middle and thicker on the edge.
- **Plus lenses**: Lenses made to compensate for far sightedness. This lens will converge light or an image. It is thicker in the middle and thinner on the edge. This the same as a magnifying glass.
- **Compound lenses**: These lenses have two distinct curves, a sphere and cylinder. This is used to correct astigmatism.
Cylinder curve  
The cylinder curve is ground into a lens to correct astigmatism. This curve is just like a side of a can.

Multifocal lenses  
These lens have two or more areas of added plus power for reading up close. Examples include: Bifocals, trifocals and progressive lenses.

The Add  
This is the area added to a lens for more plus power. This is for a presbyopic refractive error.

**Video 4A  Plus and Minus prescriptions and transposition**

Compound lenses have 2 distinct curves in them to correct astigmatism, the sphere and cylinder powers. A typical RX will look like this: -1.00 -1.00 X 142. The first number is the sphere power, the second is the cylinder and the third is the axis. The RX can also be written in two forms called plus cylinder and minus cylinder. The previous example is a minus cylinder form. An example of a plus cylinder would be: -1.00 +1.00 X 142. The obvious difference here, the cylinder is a plus power. In the optical industry there are these two ways to write any prescription. Depending on the doctor and the way he or she was trained they will write their prescriptions either in plus or minus cylinder. In many cases an optometrist will refract in minus cylinder and an ophthalmologist will refract in plus cylinder but this is not always the case. You will probably run into both forms so you need to be familiar with them. When the RX is sent to the lab you could send it as is or transpose it to the form you normally use. The lab will always grind in minus cylinder and will transpose any plus cylinder form into minus.

Any optician needs to be able to transpose any prescription in their daily work. This is very simple and works as follows: As our first example an rx reads -4.50 -1.00 X 34 First take the sphere and cylinder power and add them together.

\[-4.50 + (-1.00) = -5.50\]

Now change the sign of the cylinder, here it will be a +1.00. Then change the axis by 90 degrees. 34 + 90 = 124. The new RX is:

\[-5.50 +1.00 X 124\]

The next example is +1.50 +2.25 X 147. So +1.50 + +2.25 = +3.75. Change the sign to a -2.25 and the axis is 147 – 90 = 57. The new RX reads +3.75 – 2.25 X 57.

Here is one a little different. -1.00 + 1.50 X 89. -1.00 + +1.50 = +.50. The cyl is now -1.50 and the axis is 89 + 90 = 179. The RX is now +.50 -1.50 X 179

That is all there is to transposition.

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