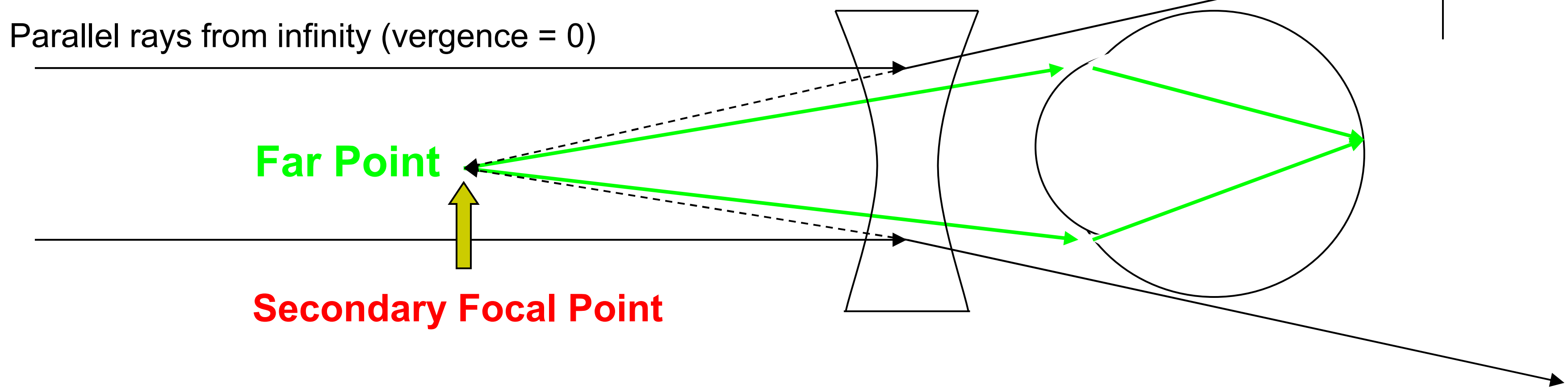
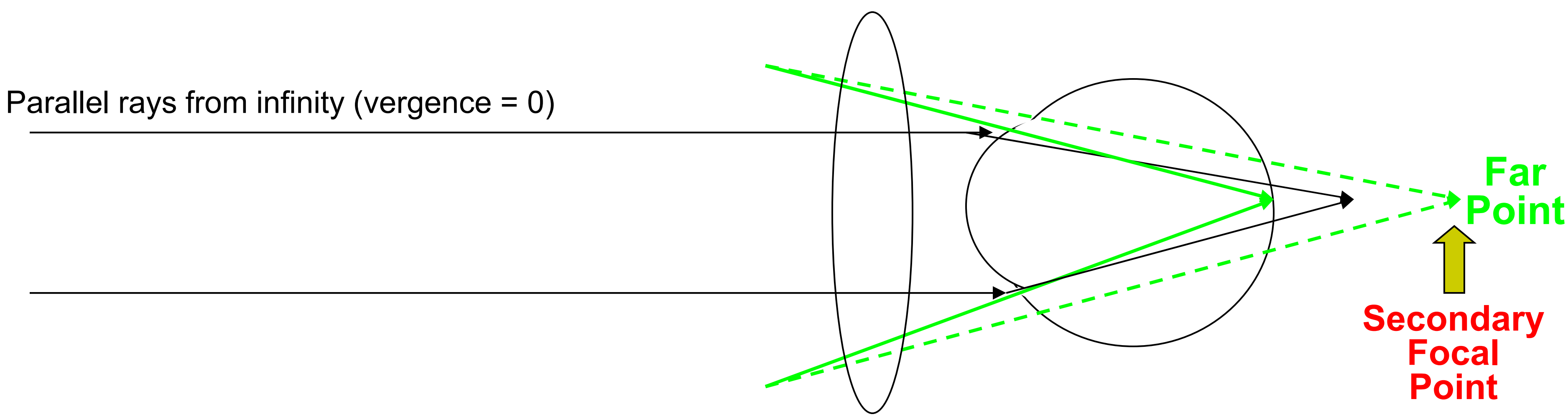
Vertex Distance

Basic Optics, Chapter 7

Vertex Distance



Last chapter we saw that correcting refractive error consists of placing a lens in front of an eye so that the secondary focal point of the lens coincides with the far point of the eye. ***But note:***



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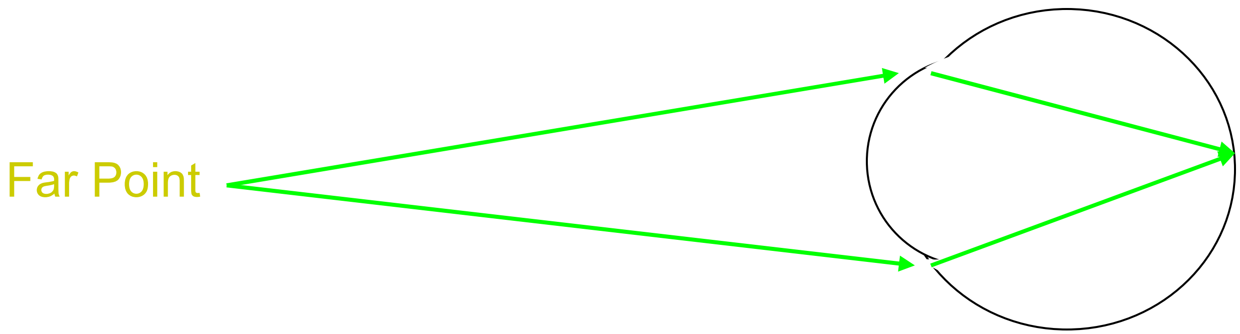

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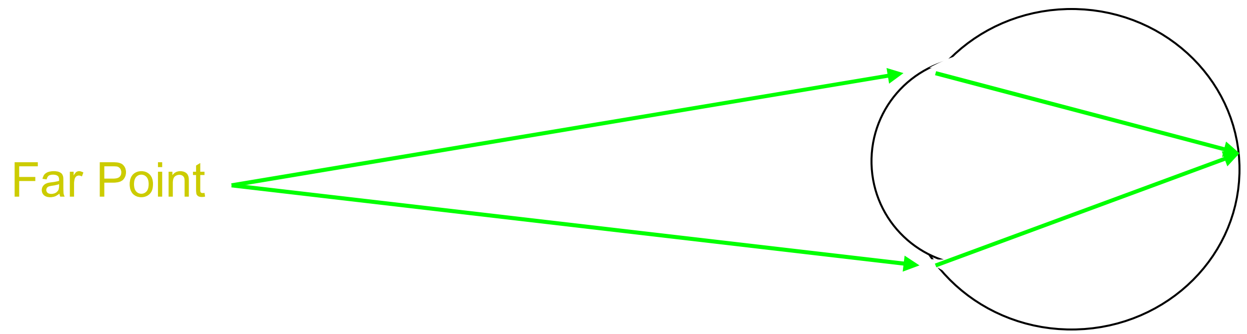

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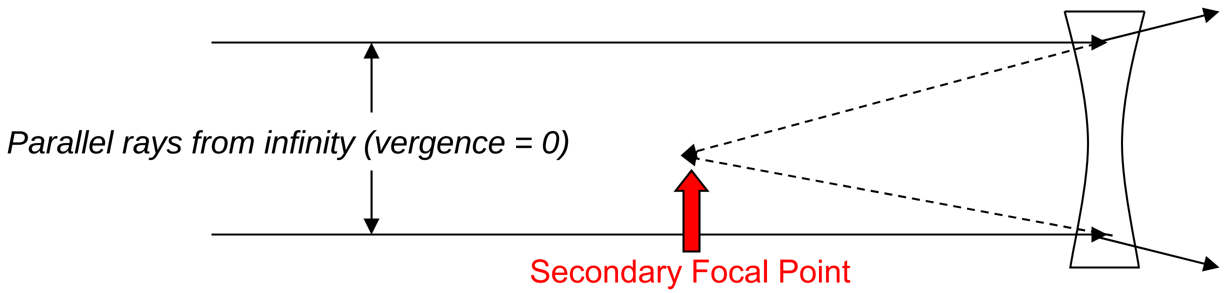

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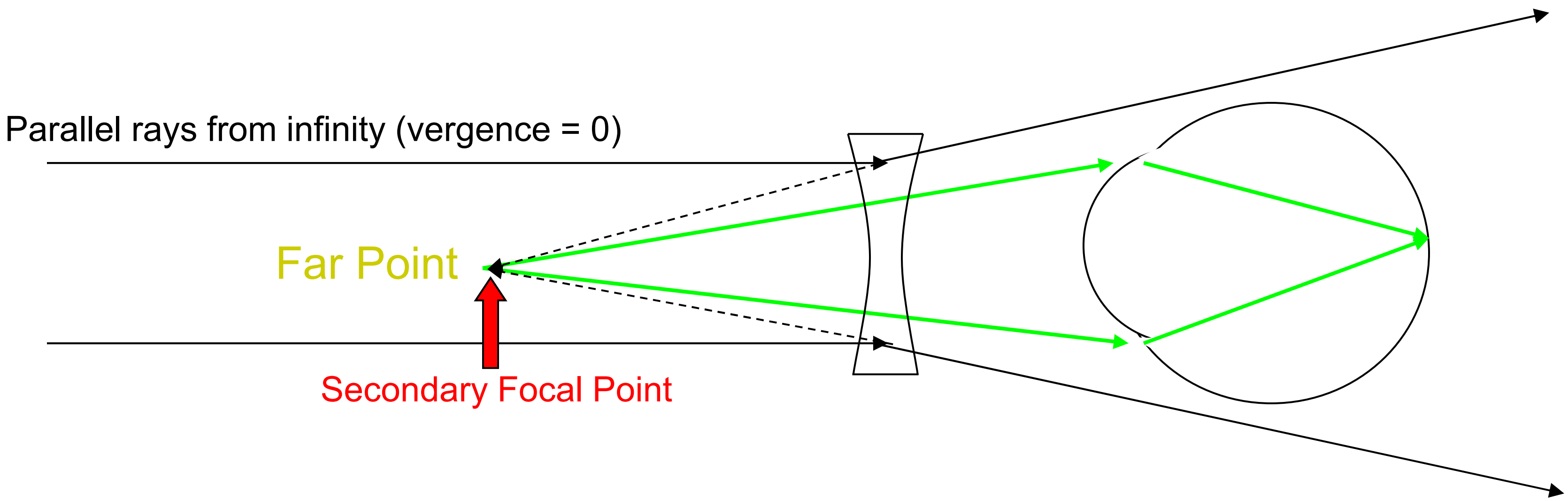

1) The distance from an eye to its far point is fixed (unless refractive surgery is performed).
2) Likewise, the distance between a lens and its secondary focal point is also fixed.
3) Finally, remember that to correct refractive error, *the corrective lens must be located so that its secondary focal point overlaps the far point of the eye.*

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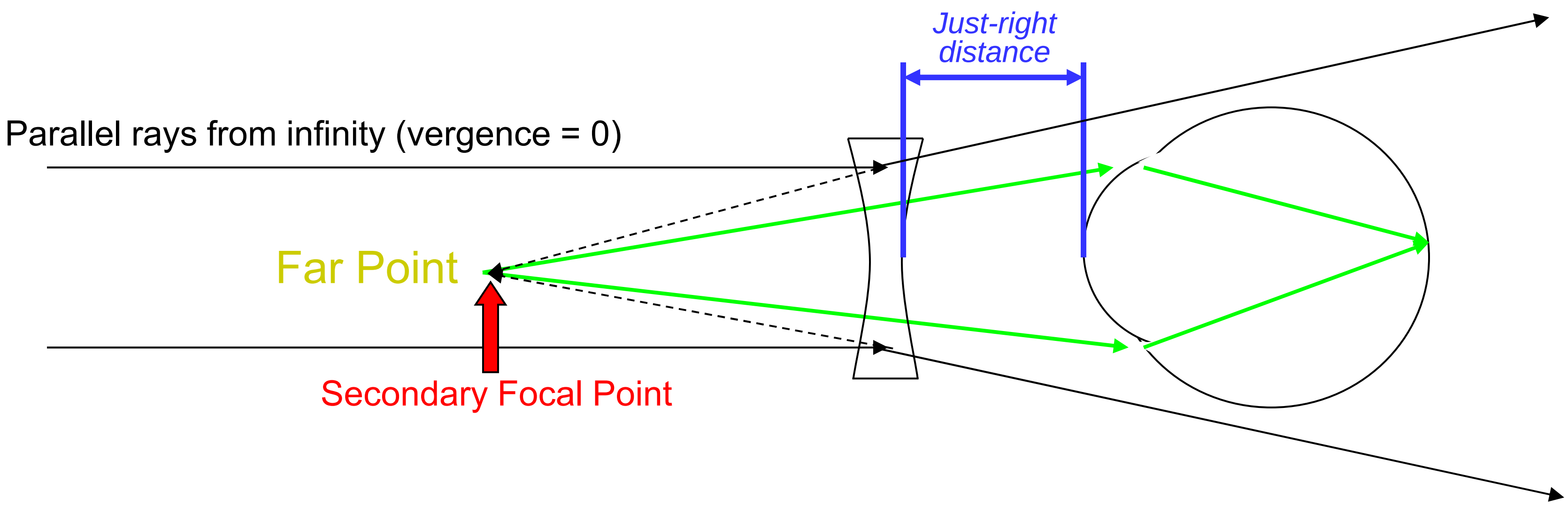
Because both the retina-to-far point and lens-to-secondary focal point distances are fixed, it follows that *a given lens will work only if it is placed at just the right distance from the eye*. **For example…**



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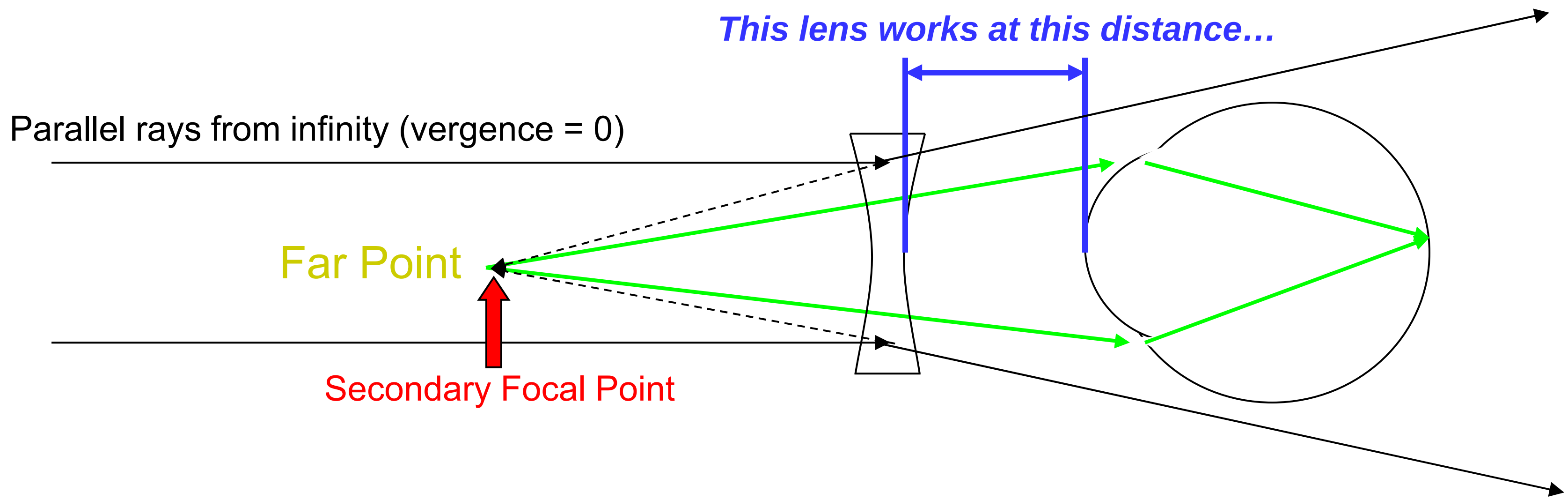

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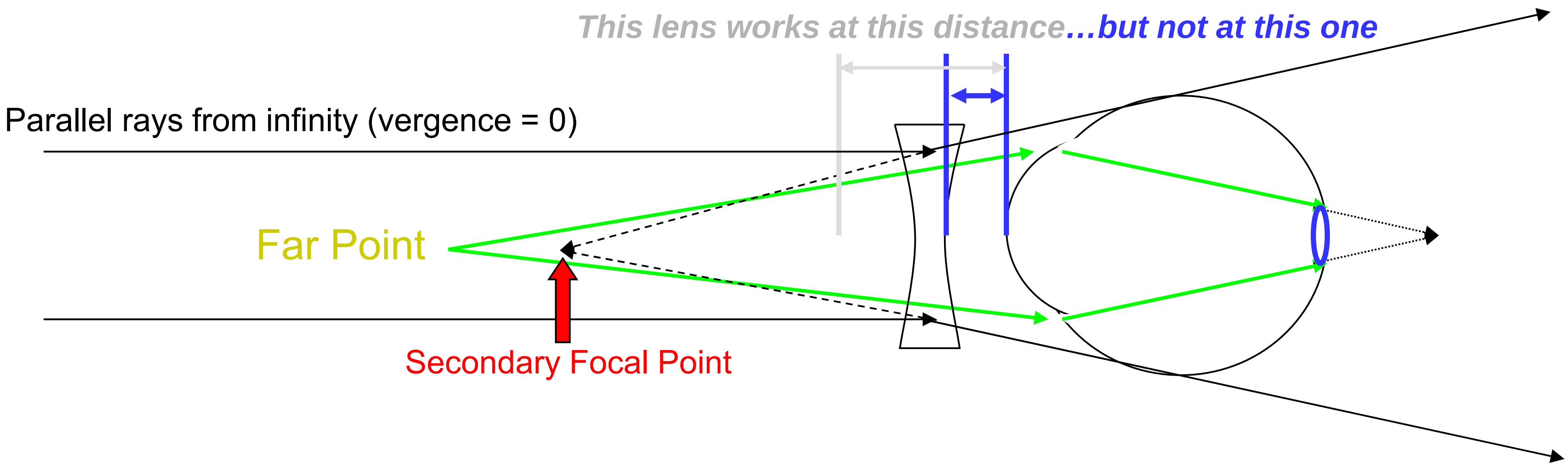

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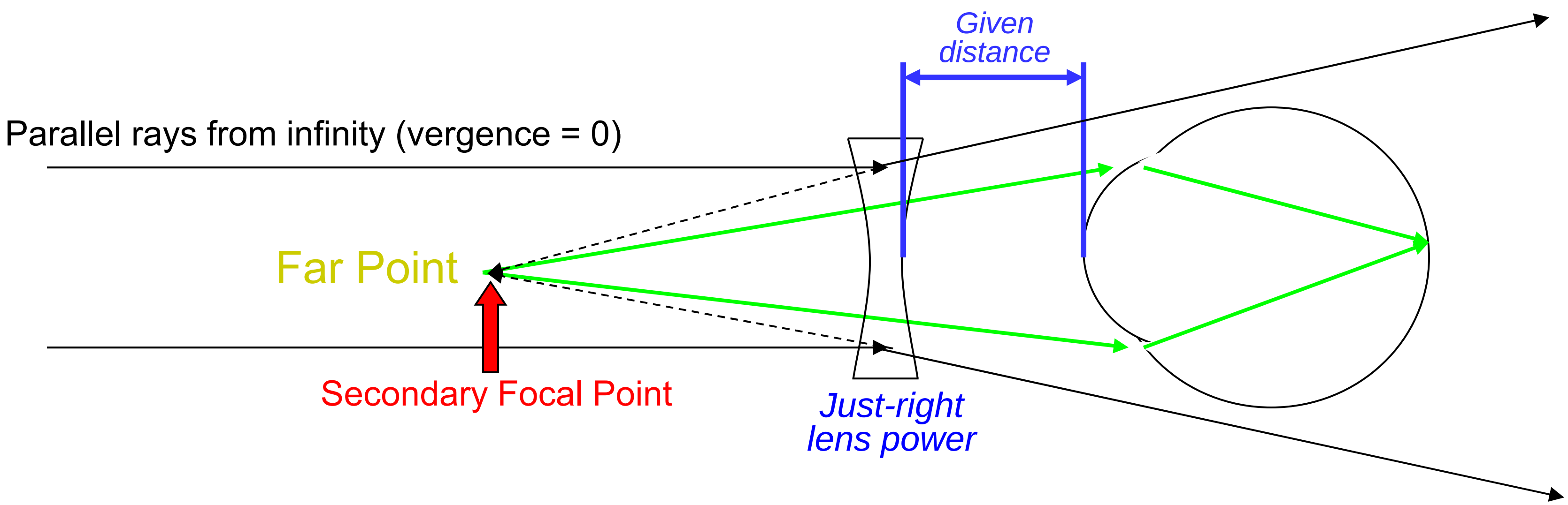

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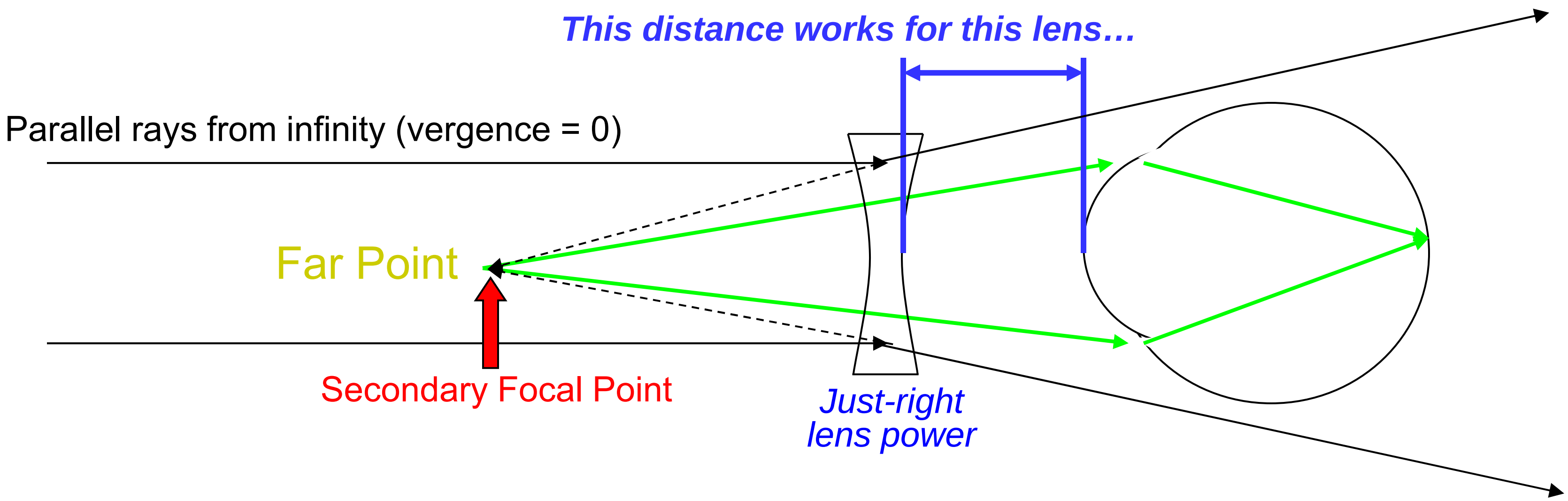

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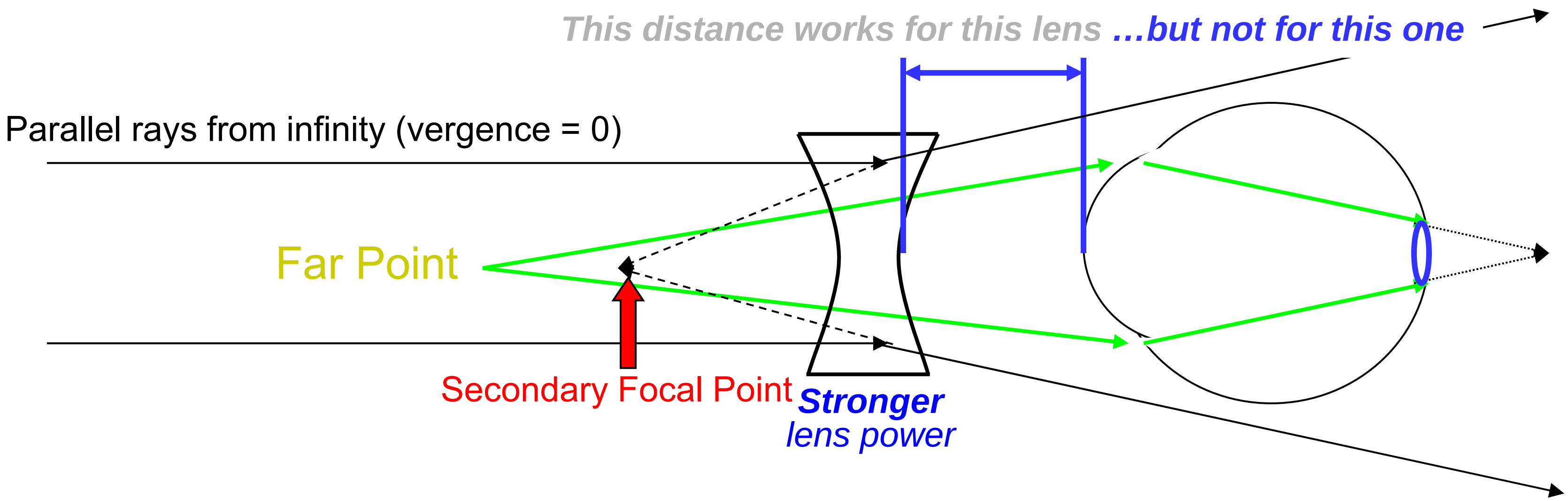

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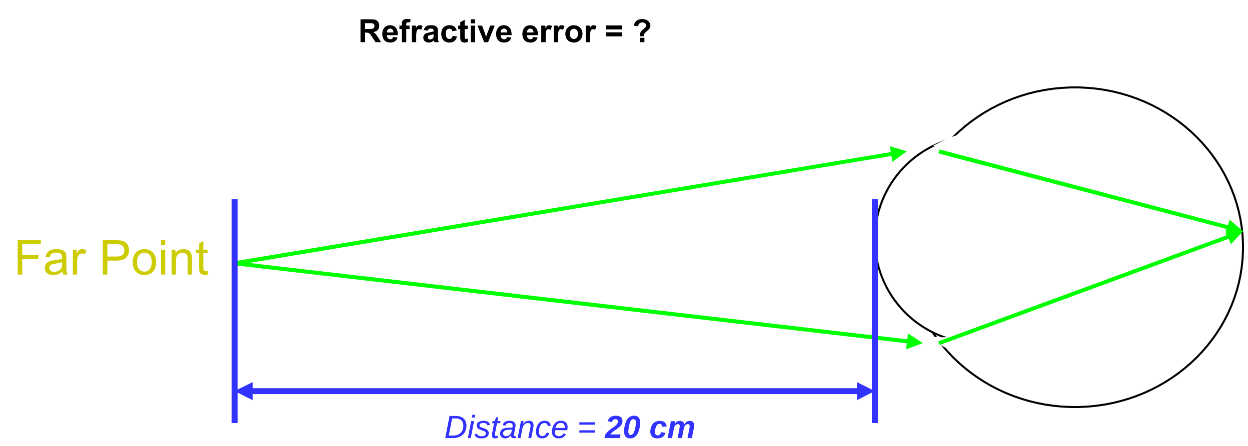
  - Specifically, the vertex distance is measured from the corneal surface to the *back* of the lens
- Vertex distance is an important variable when dealing with moderate-to-high refractive error
  - Rule-of-thumb: When writing a spectacle Rx with a power of +/-5D or more, specify the vertex distance at which the patient was refracted

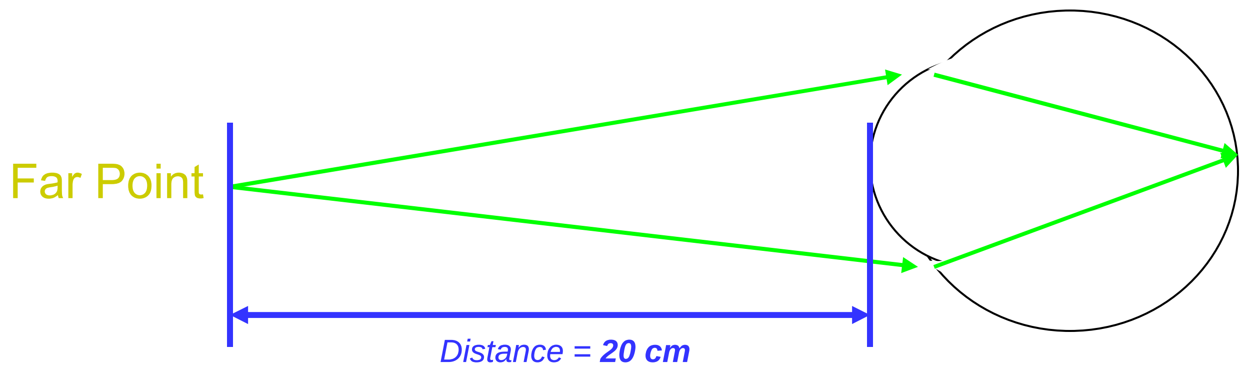
Vertex Distance



The far point of this eye is 20 cm anterior to the corneal plane. What is its refractive error in diopters?

Vertex Distance

Refractive error = ?



The far point of this eye is 20 cm anterior to the corneal plane. What is its refractive error in diopters?

We know the dioptric power is equal to 1 m divided by the distance from the eye to the far point, so dioptric power = 1/.20 = 5.

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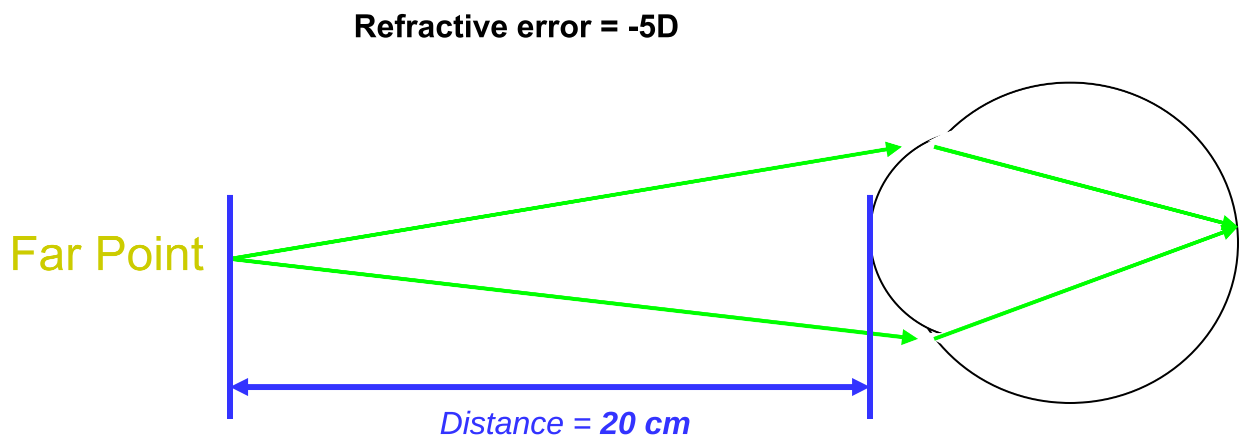

The far point of this eye is 20 cm anterior to the corneal plane. What is its refractive error in diopters?

We know the dioptric power is equal to 1 m divided by the distance from the eye to the far point, so dioptric power = 1/.20 = 5. Thus we know that the refractive error of this myopic eye is -5D.

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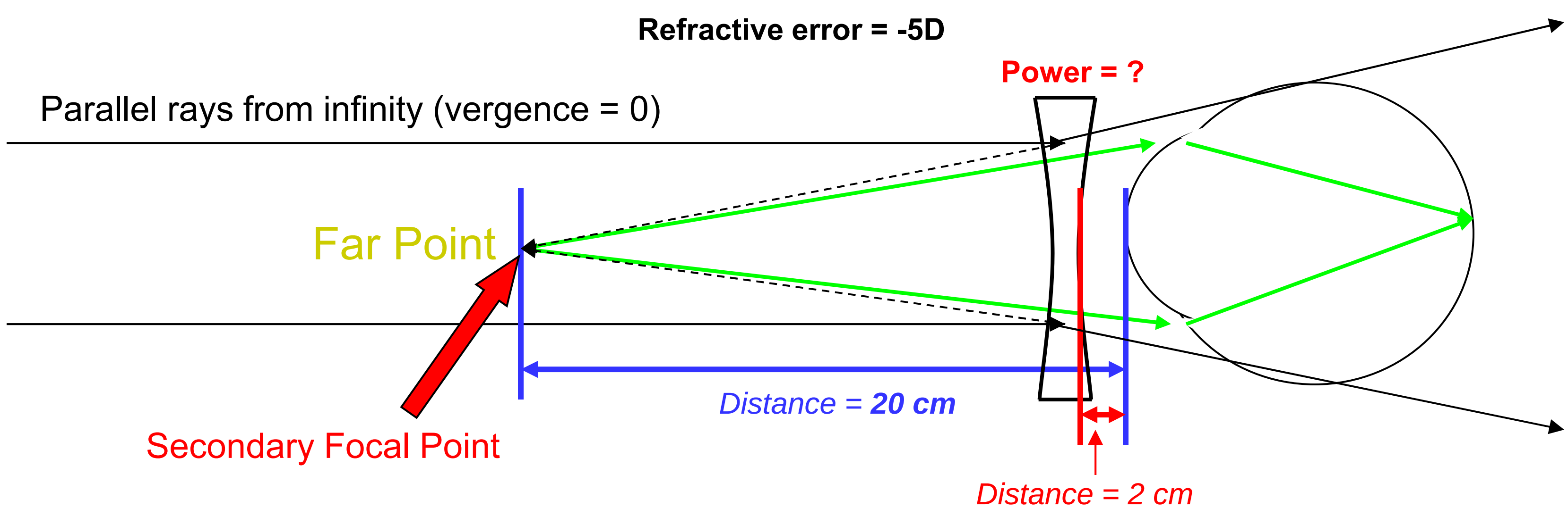

Now assume this eye is to be fitted with a spectacle at a vertex distance of 20 mm (2 cm). What is the proper lens strength to allow clear distance vision?

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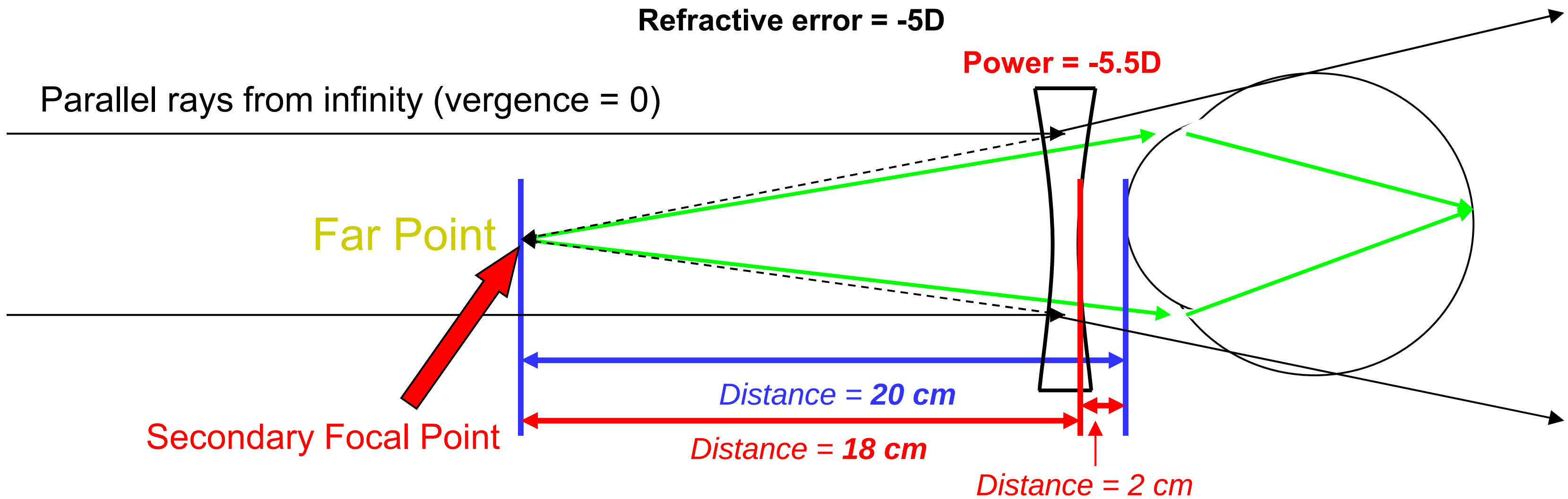
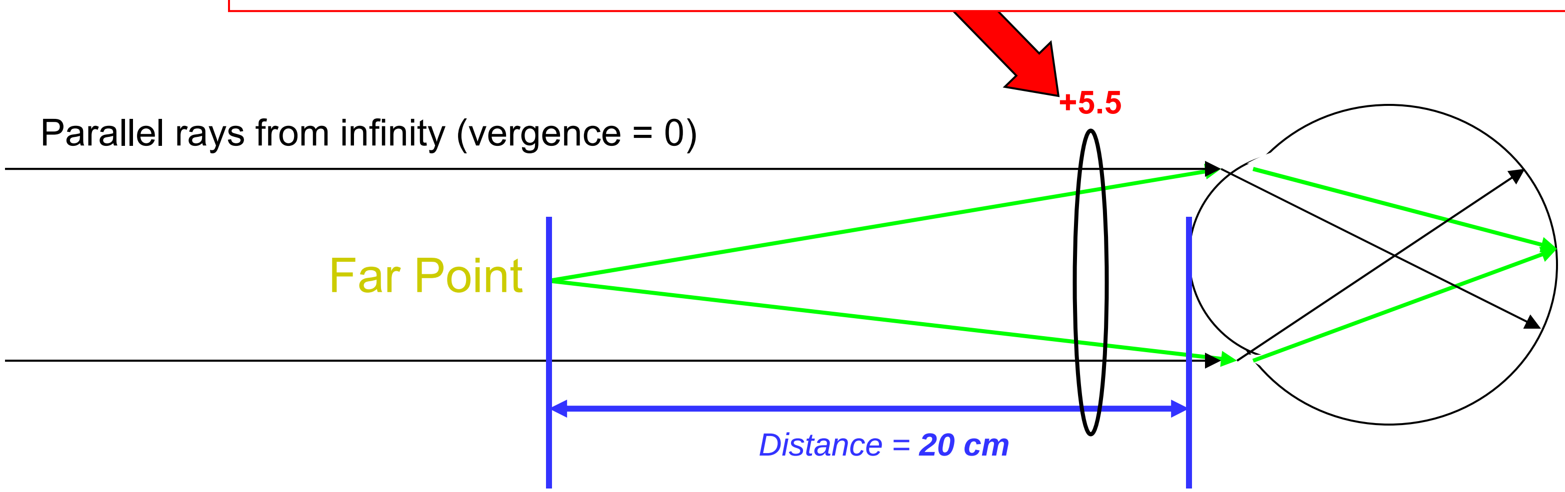


Now assume this eye is to be fitted with a spectacle at a vertex distance of 20 mm (2 cm). What is the proper lens strength to allow clear distance vision?

-5.50D. Note that the lens will be located 18 cm from the far point of the eye. Therefore, in order for the secondary focal point of the lens to coincide with the far point, a lens with a secondary focal length of 18 cm is needed. The dioptric power of such a lens equals 100 cm/18 cm, or 5.55, which rounds to 5.50. Vertex distance problems are definitely in-play on the OKAPs!

Vertex Distance

But consider this: *What if the only lens available was a* **PLUS** *5.5?*
Is there any way to give this myopic patient clear vision with such a lens?



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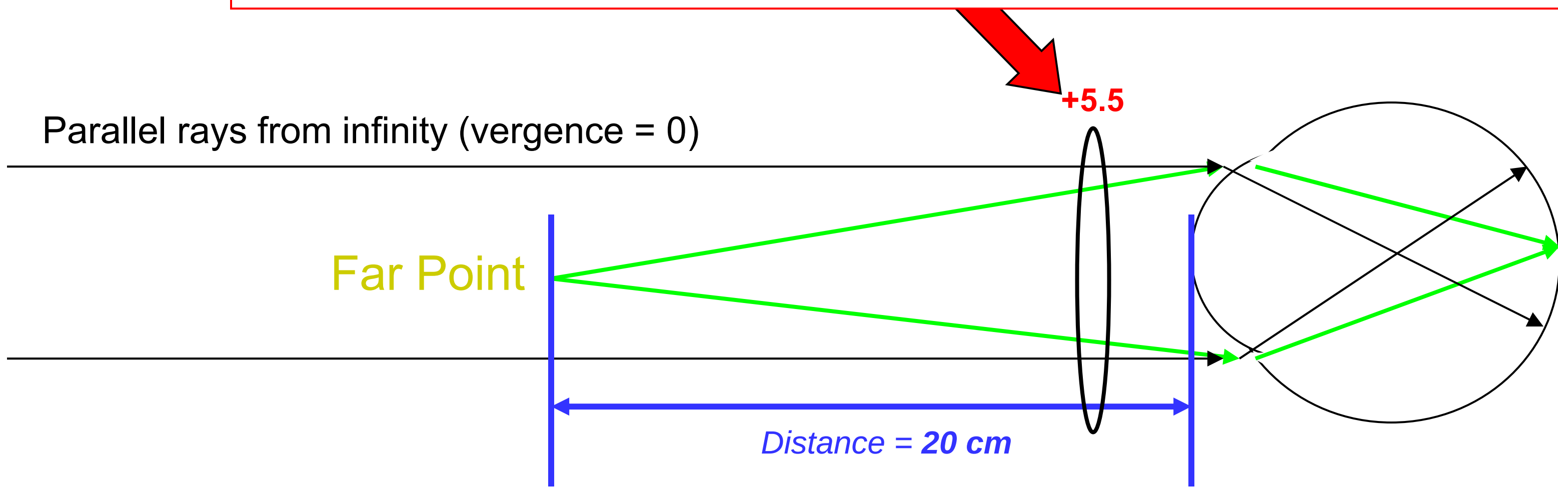
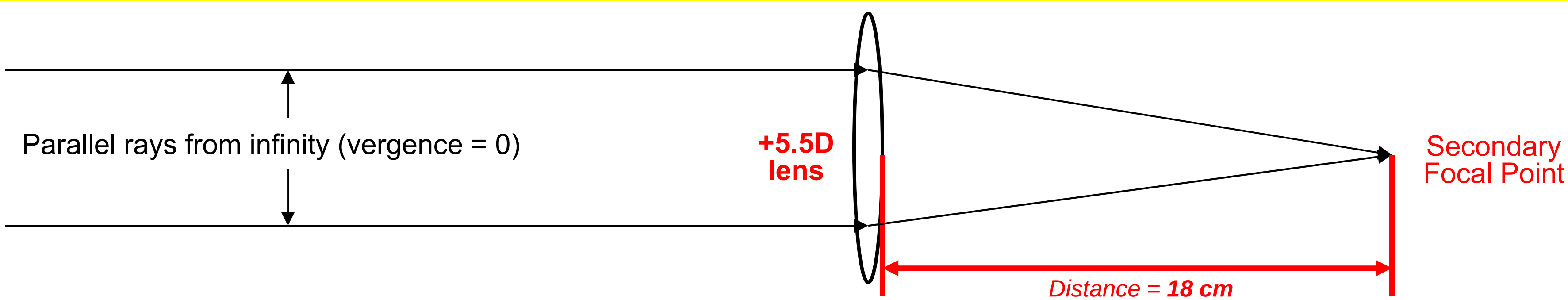


Before answering, consider the relationship between a +5.5D lens and its secondary focal point:



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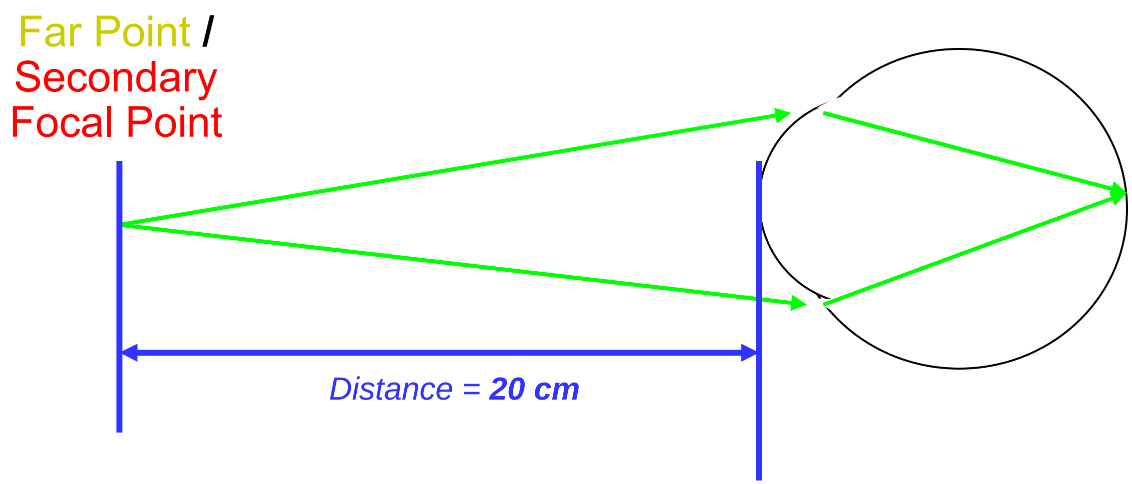

Surprisingly, the answer is **YES,** although it would not be terribly useful vision. In order to provide clear vision, we need to align the secondary focal point of the lens with the far point of the eye.

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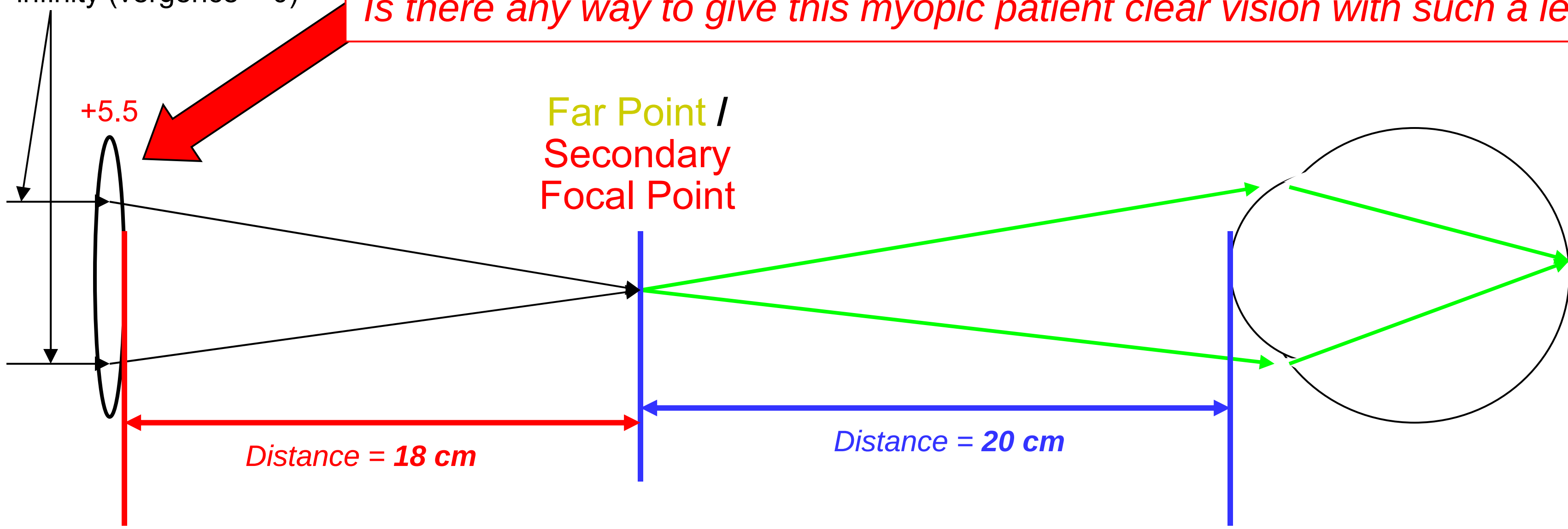

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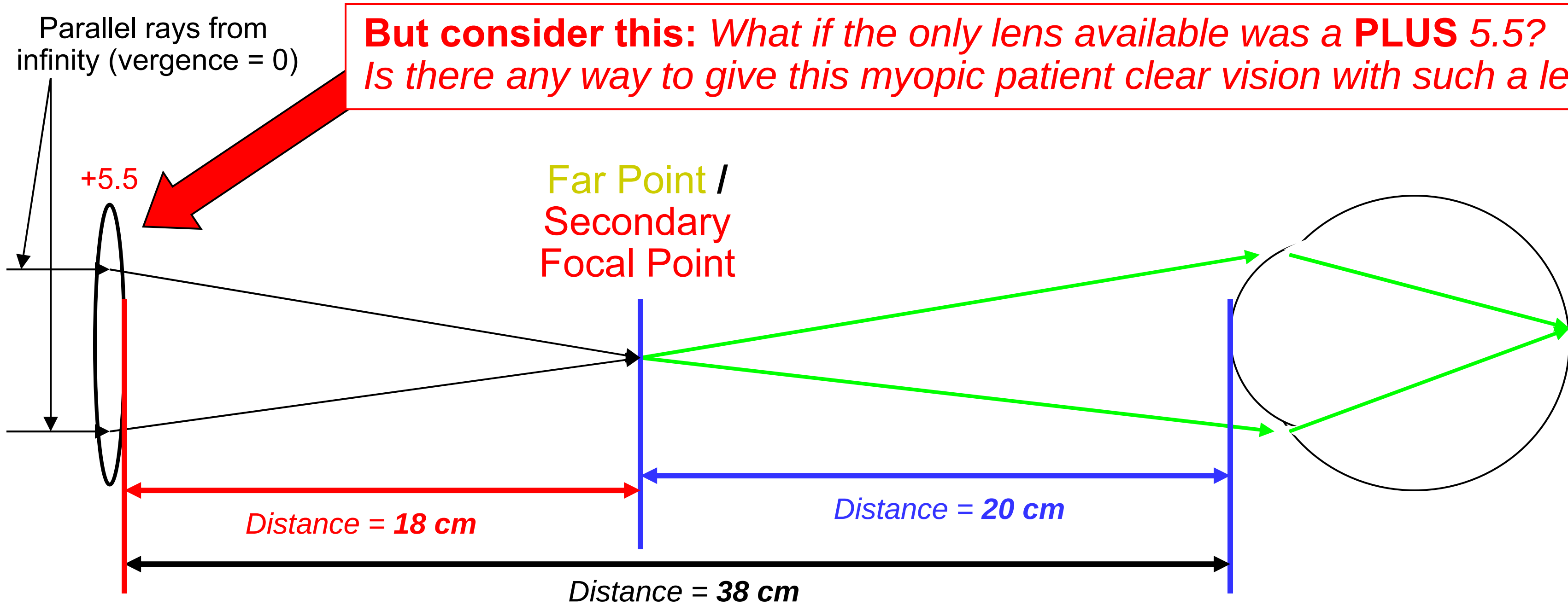

Surprisingly, the answer is **YES,** although it would not be terribly useful vision. In order to provide clear vision, we need to align the secondary focal point of the lens with the far point of the eye. A +5.5D lens has a focal length of about 18 cm (100/5.5). Therefore, a +5.5D lens would provide a sharp retinal image if it were located 18 cm *to the left* of the far point—in other words, at a vertex distance of 38 cm.

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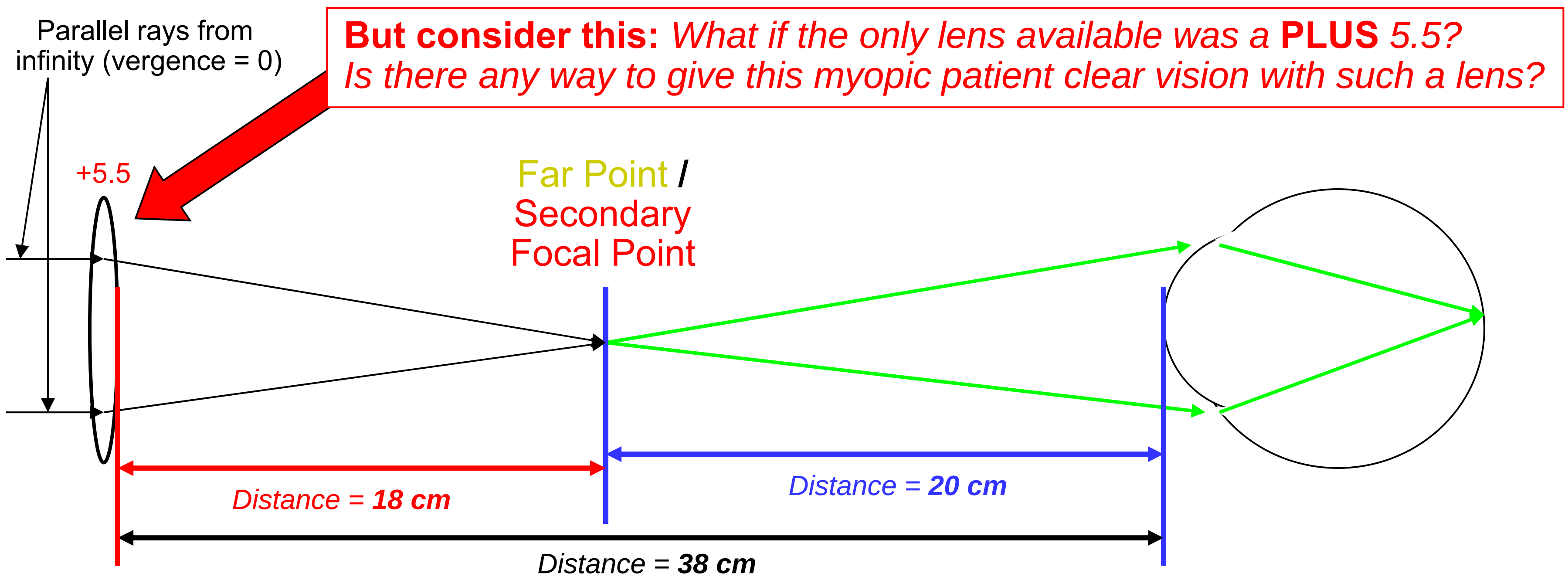

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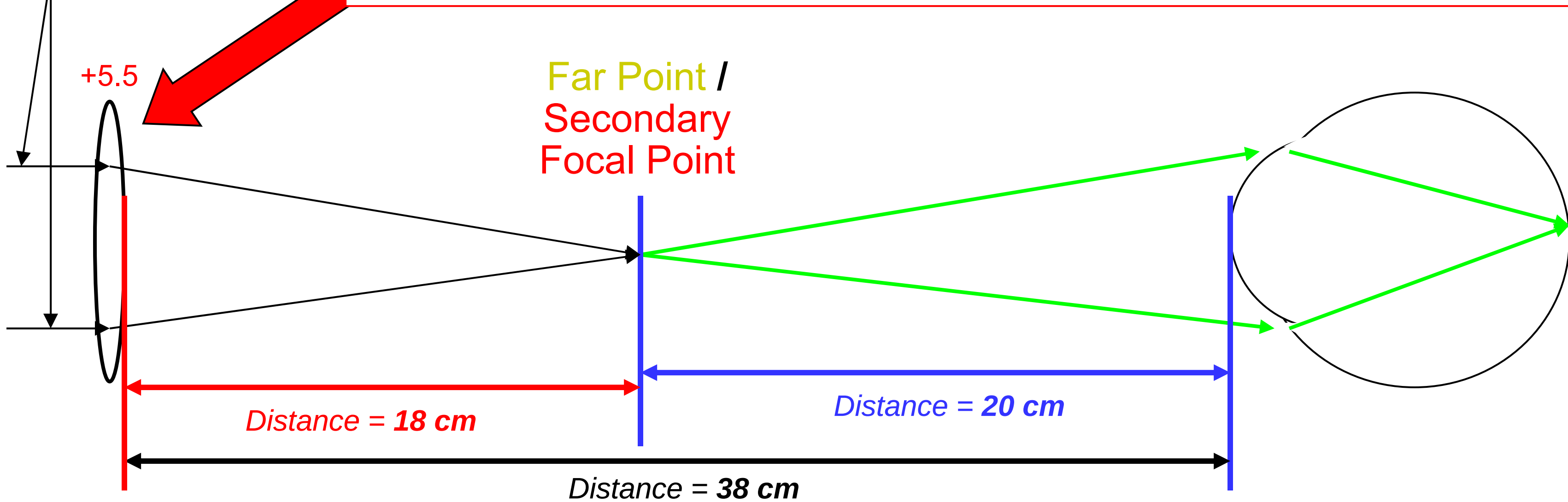

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The retinal image, while perfectly sharp, is pǝʇɹǝʌuᴉ, and the field of view would be **very** small.