Clinical Astigmatism

Information for Patients Considering Astigmatic Management During Cataract Surgery

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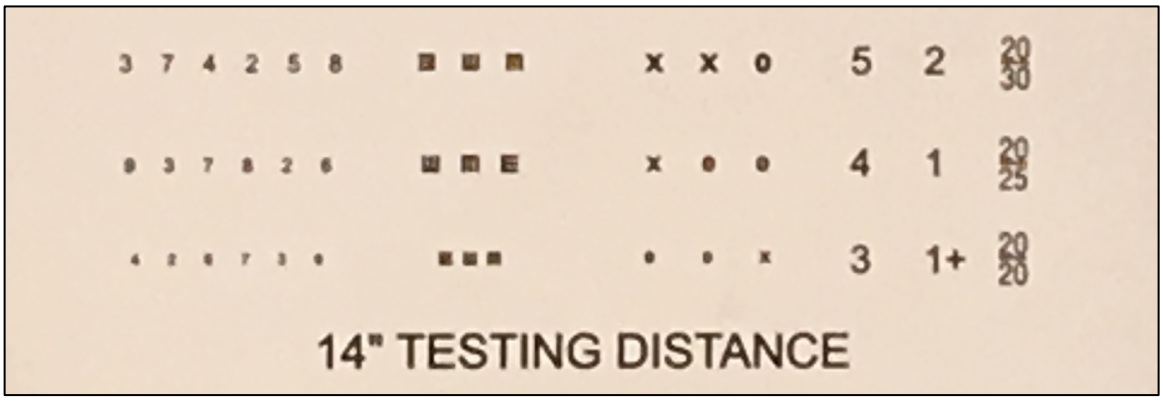
Introduction

This paper is written for patients with astigmatism who are considering cataract surgery. Astigmatism can be managed during cataract surgery, and this can have a profound effect on your visual outcome.

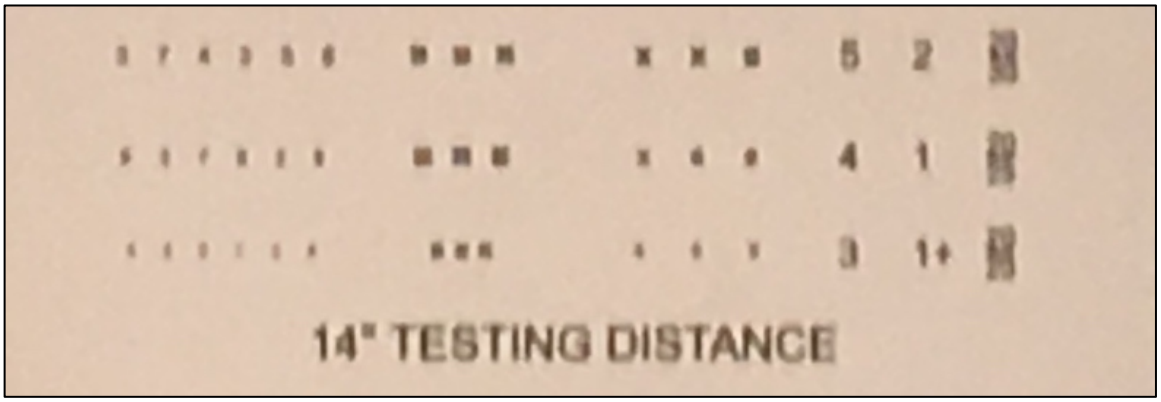
Astigmatism blurs your vision at all distances. This is because the eye has a different curvature in one dimension than the other, for example a steeper vertical curvature than horizontal curvature. Picture a football: This is like astigmatism.

Below are two near cards. The first is with no astigmatism. The second shows the effect of 1.00 Diopter of astigmatism.

No Astigmatism



1.00 Diopter Astigmatism



About 34% of patients have 1.00 Diopter or more of astigmatism as demonstrated by the images above. This astigmatism can be treated during cataract surgery with toric lens astigmatic technology. If you have a 1.00 Diopter or more of astigmatism, you will need to wear glasses after cataract surgery in order to see well.

Next: Technical Explanation of astigmatism

In the next section, you will learn about how astigmatism affects the optics of the eye and your visual experience.

Astigmatism

The discussion of astigmatism begins with spherical refractive error.

Figure 1 demonstrates spherical myopia.

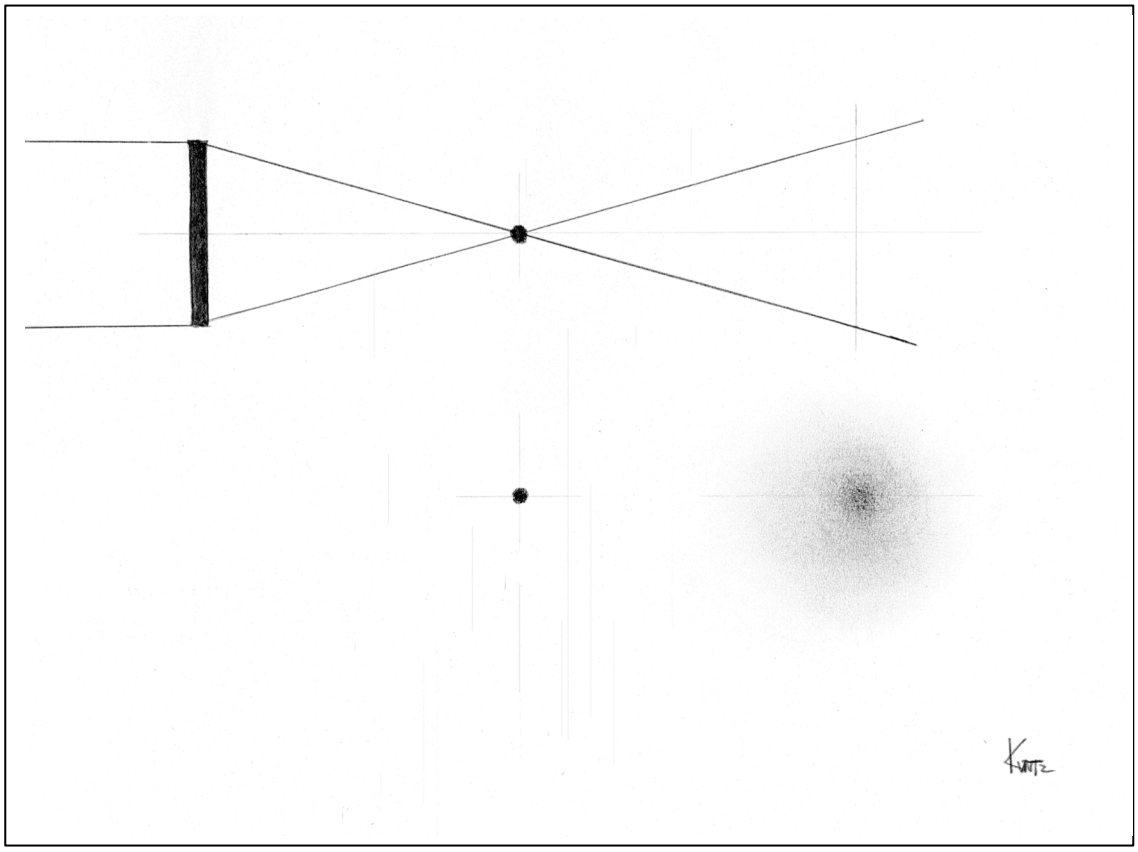


Figure 1. Myopia. Top: Ray tracing. Bottom: frontal view

Top: The rays of light in the top picture are emanated from dot located out of sight in the distance to the left. The rays of light pass from left to right through a non-astigmatic optical system and focus the dot at the focal point.

Bottom: The bottom picture demonstrates the images generated at the focal point, and at distance. The nearsighted person sees a focused dot at the focal point, and a fuzzy circle at distance.

In a non-astigmatic optical system, a unique focal point exists. Objects will become progressively blurry as the target moves closer (to the left) or further away (to the right) relative to the focal point. This is shown in **Figure 2** below:

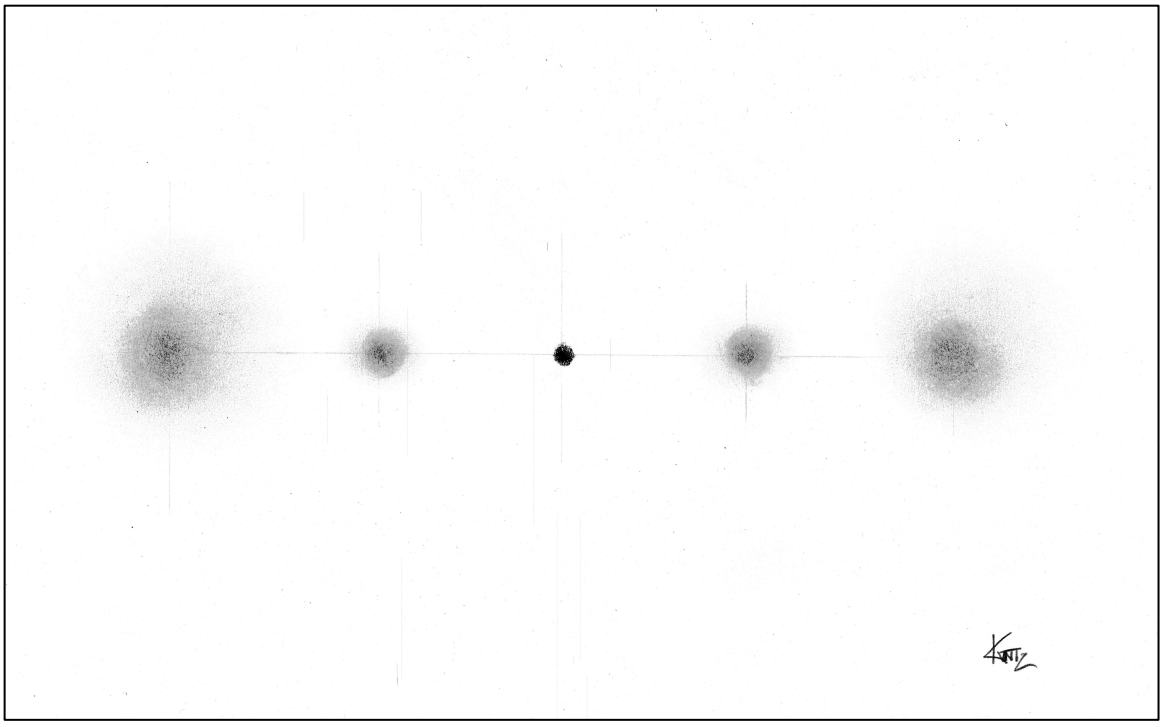


Figure 2: Non accommodating spherical optical system.

Blur is greater when the target is moved closer or (left) or further away from (right) the focal point.

Figure 3 demonstrates the images generated by low and high myopia. The low myope (top) focuses at the dot, and distant objects are blurred. The high myope (bottom) focuses closer in, and the distance blur is greater.

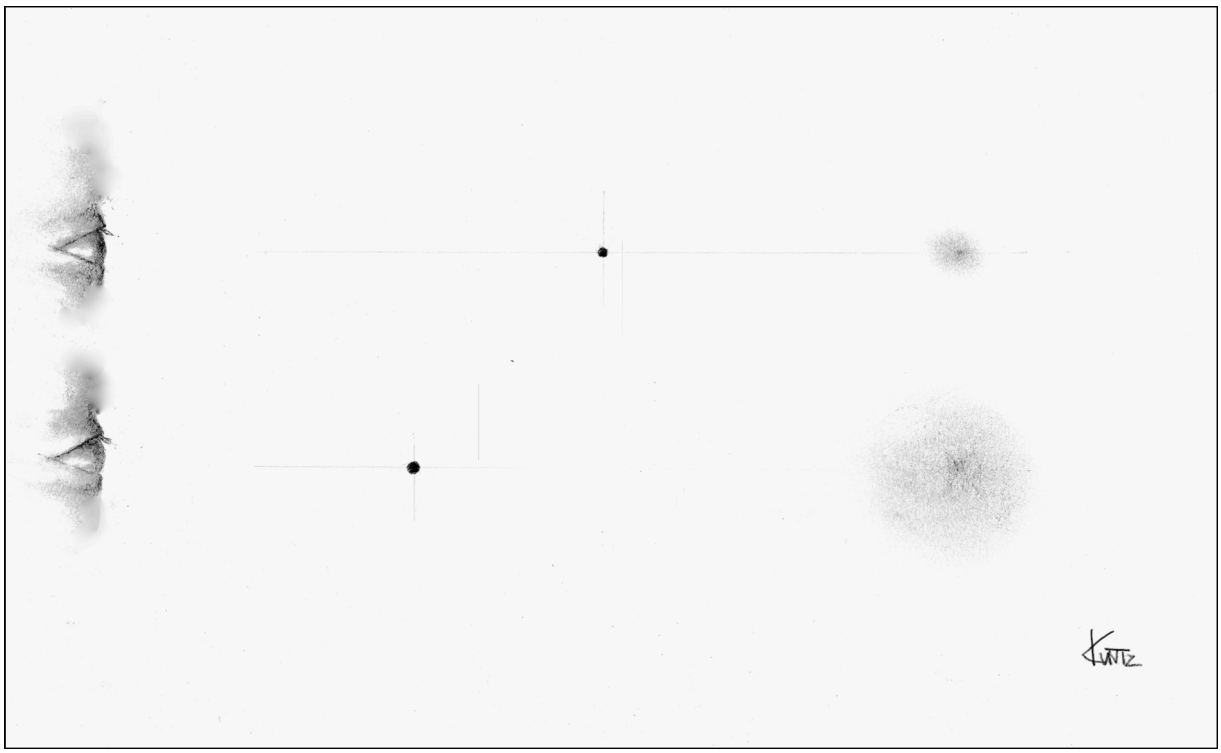


Figure 3: **Low and High Myopia** Top: low myopia. Bottom: high myopia

This understanding of spherical refractive error is now applied to astigmatism, beginning with a definition of astigmatism:

An astigmatic optical system focuses light equally and simultaneously at two different distances.

Figure 4 (below) demonstrates an astigmatic optical system. Light focuses equally and simultaneously at two different distances. In the top picture, the inner focal point and an outer focal point are identified. The bottom picture represents the image generated at each focal point.

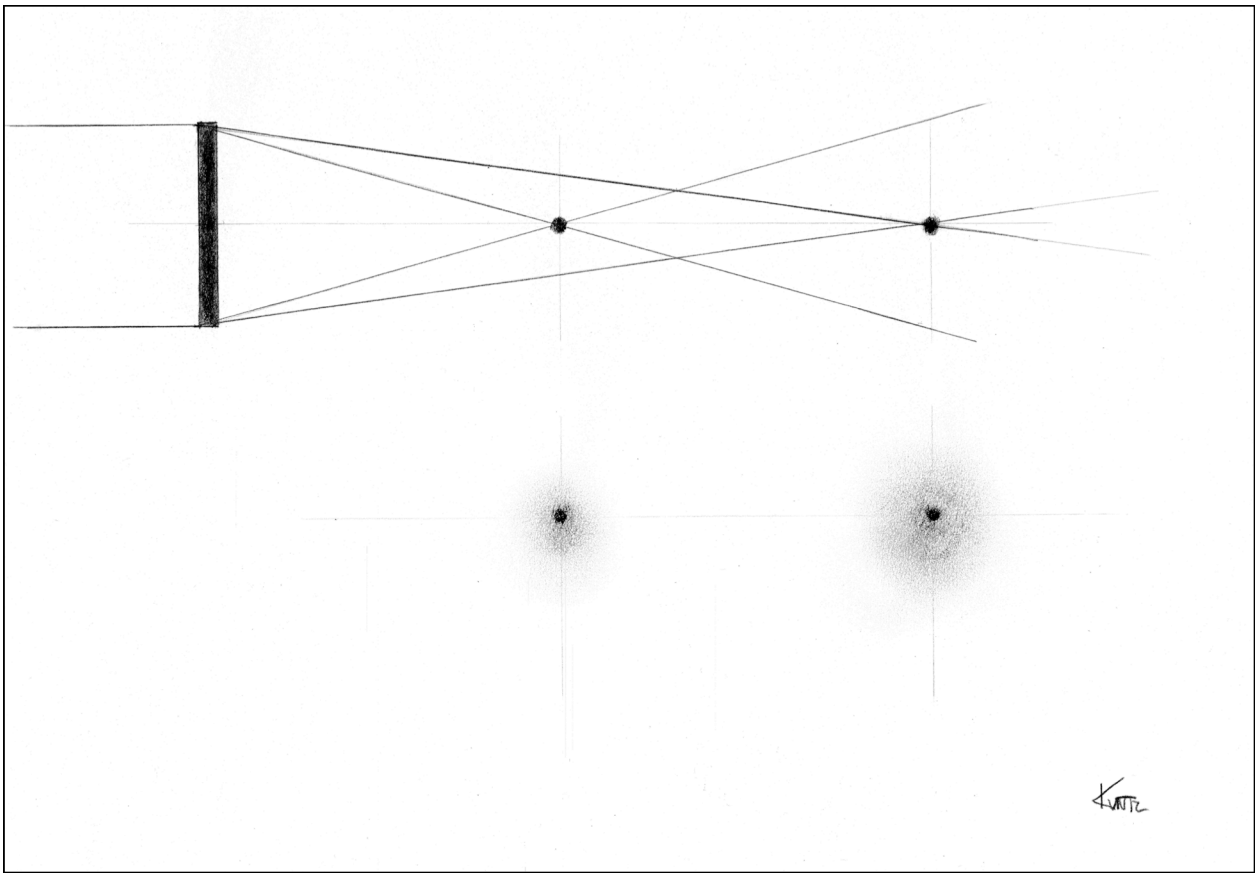


Figure 4. Astigmatic optical system. Top: ray tracing. Bottom: subjective image.

At the inner focal point, half of the optical system focuses the dot, and half is out of focus. This is *inner clear-blur*. The same phenomenon occurs at the outer focal point, resulting in *outer clear-blur*.

Figure 5 (below) demonstrates the difference between low and high astigmatism. With low astigmatism (top picture), the focal points are closer together and the blur at the inner and outer focal points is less. The *least common blur* between these two points is also less pronounced. With high astigmatism (bottom picture), the two focal points are farther apart, the blur surrounding each focal point is greater, and the least common blur between the focal points is more pronounced.

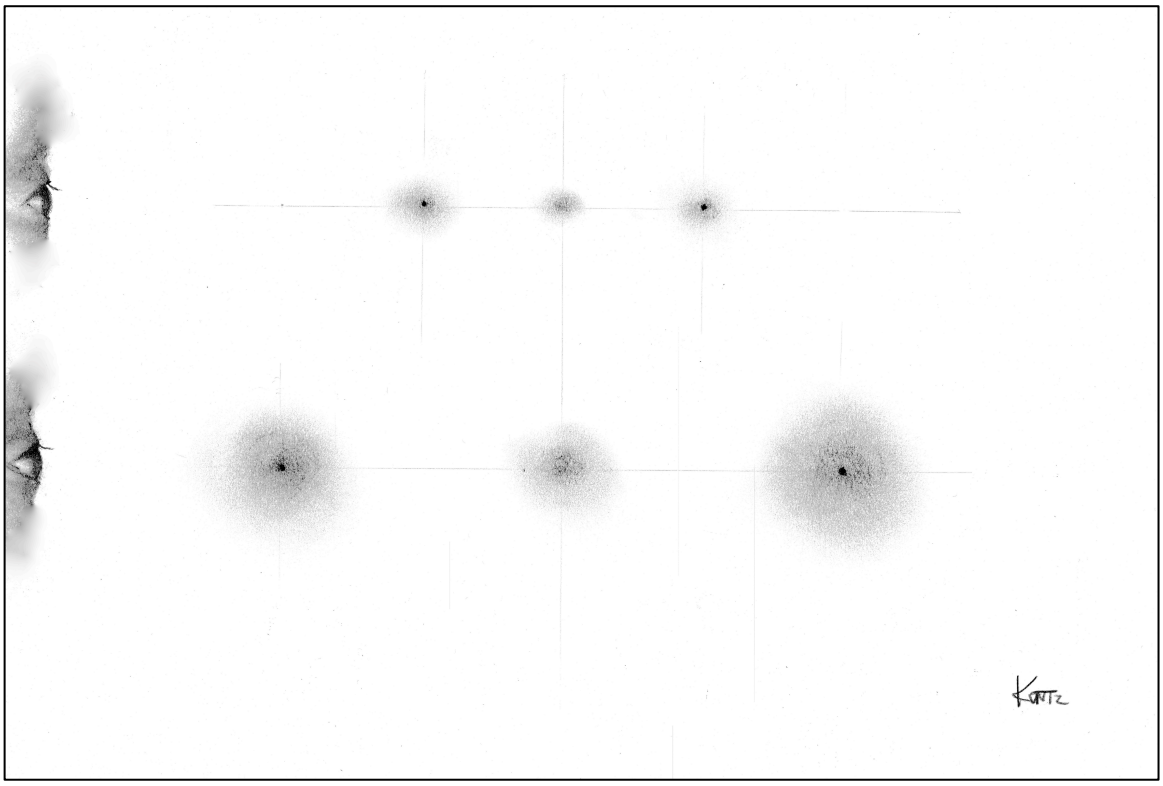


Figure 5. Low and high astigmatism. Top: Low astigmatism. Bottom: high astigmatism

As astigmatism increases, the distance between the inner and outer focal points increases, and the least common blur becomes more pronounced.

Figure 6 compares myopia (top) with astigmatism (bottom).

For the myope (top picture), objects are either completely in focus or out of focus. For the astigmat (bottom picture), three optical phenomena occur: *Inner clear-blur*, *least common blur*, and *outer clear-blur*.

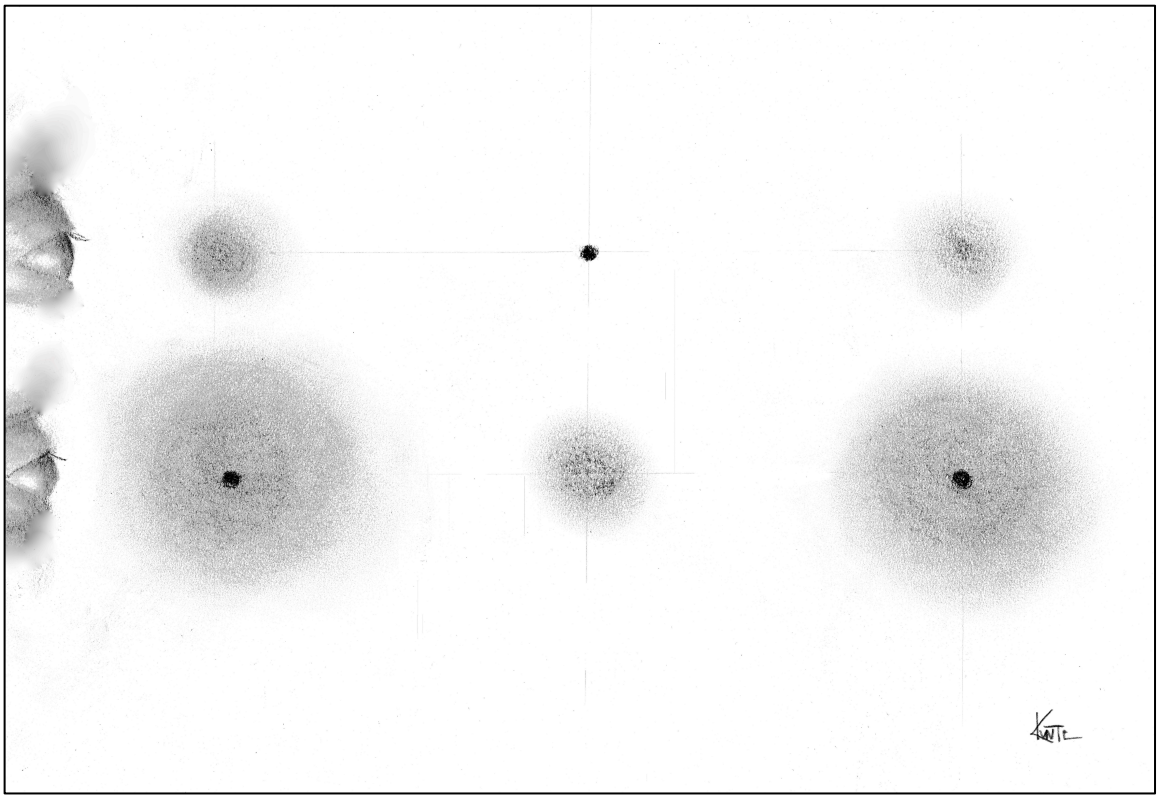


Figure 6: myopia (top) and astigmatism (bottom).
Myopia (top) creates two simple refractive states; *clear* and *blur*. Astigmatism (bottom) creates more complex refractive states: *Inner clear-blur, least common blur*, and *outer clear-blur*.

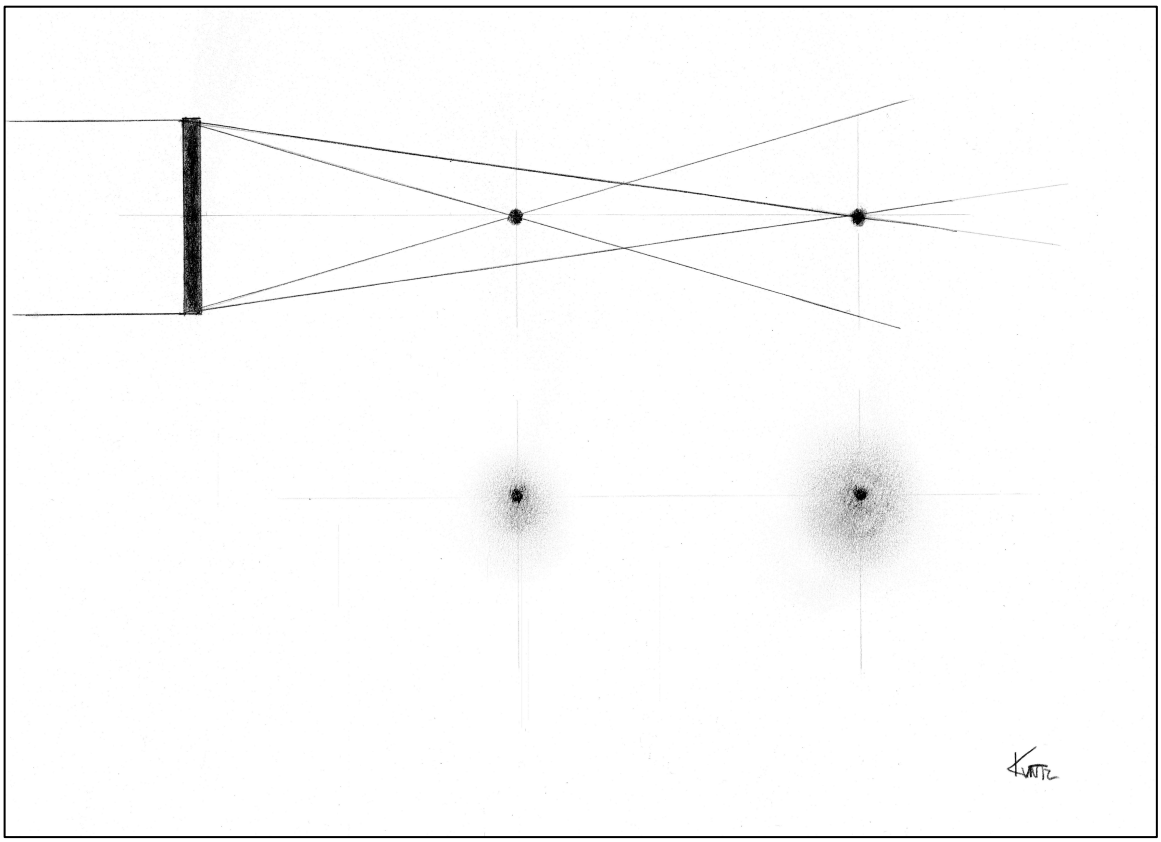
Summary:

An astigmatic optical system focuses light equally and simultaneously at two different distances.

Astigmatism creates three important optical phenomena: *inner clear-blur, least common blur,* and *outer clear-blur*.

As astigmatism increases, the distance between the inner and outer focal points increases, and the least common blur becomes more pronounced.

If you anticipate having 1.00 Diopter or more of astigmatism after cataract surgery, you may want to consider astigmatic management during cataract surgery.



For more information, see www.chriskuntzmd.com.