

i This is a preview of your site. To make your latest changes available to your visitors, be sure to publish! [Learn more.](#)



I-site
Amsterdam
Netherlands
i-site@netherlens.com

- [Home](#)
- [Archive](#)
- [May 2010](#)
- [Downloads](#)

Designing a Toric (R)GP Contact Lens - Art or Science?

Key words: Corneal Astigmatism, Corneal Topography, Toric (R)GP lens fit, Fluorescein Pattern

Introduction

The management of astigmatism with gas permeable (R)GP contact lenses in any practice can be intimidating with respect to complexity of fit and time. This leads to the question, is the prescribing of toric (R)GP contact lenses an art or a science?

Let's first review what makes an ideal lens-to-cornea fitting relationship with any (R)GP lens, whether spherical or toric. There are three fit factors that need to be achieved.

First: The center of the contact lens should vault the center of the cornea, allowing for approximately 10 to 20 microns of apical clearance. In our clinical experience, this amount of clearance allows us to best mimic the thickness of the normal tear film (~3 to 40 microns¹) and provide alignment across the center of the cornea.

Second: The mid-periphery should land along the horizontal meridian to aid in centration.

Third: The lens should have unobstructed vertical movement, which is achieved by maintaining a lens-to-cornea fitting relationship that is ~1.00 D (~0.20 mm) flatter than in the horizontal meridian.

Figure 1 shows a ~1.00 D (~0.20 mm) with-the-rule (WTR) fluorescein pattern that follows these three fit factors. This pattern ensures good centration by landing the lens at 3 and 9 o'clock and provides a vertical channel for unrestricted vertical movement.

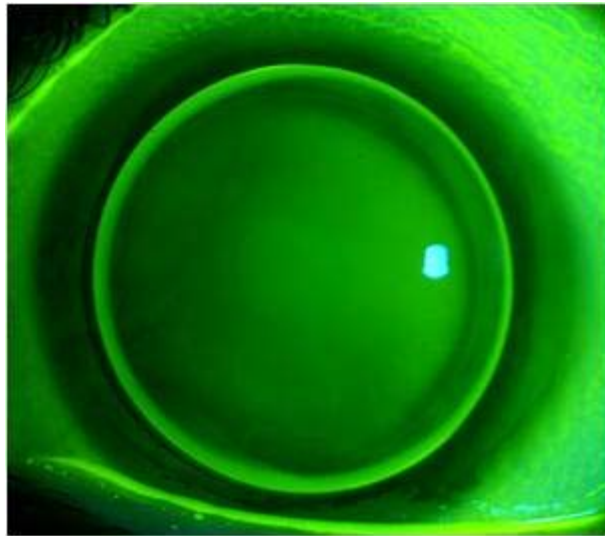


Figure 1: The ideal fluorescein pattern that achieves all three fit factors: 1) Vaults the central cornea 2) Lands at 3 and 9 o'clock 3) Unobstructed vertical movement

Maintaining centration is a key factor in both patient comfort and a properly prescribed (R)GP contact lens. In an astigmatic cornea, the two major meridians may have a difference in curvature that exceeds the limits of a spherical base curve. As was discussed in the November 2009 I-Site article by Randy Kojima, it is important to differentiate between apical astigmatism and limbus-to-limbus astigmatism when prescribing (R)GP lenses. An astigmatism contained within the central cornea will require a different lens design to accomplish our three (R)GP fit factors compared to an astigmatism that stretches from limbus-to-limbus.

Topographical Design

Determining the proper base curve can be daunting. A good corneal topography map can help determine a starting point. By visualizing the corneal curvatures centrally and peripherally, we can assess the base curve needed to achieve our fit factors. In addition, many topographers have tools that allow you to place a contact lens curvature on the topographical map to create a theoretical fluorescein pattern. In Figure 2, the topography (Atlas Topography System, Zeiss Meditec) reveals WTR astigmatism at 1.03 D (~0.20 mm). Traditionally we would select a base curve on the flattest keratometry reading or slightly steeper to allow for vaulting over the corneal apex and landing in the horizontal meridian.

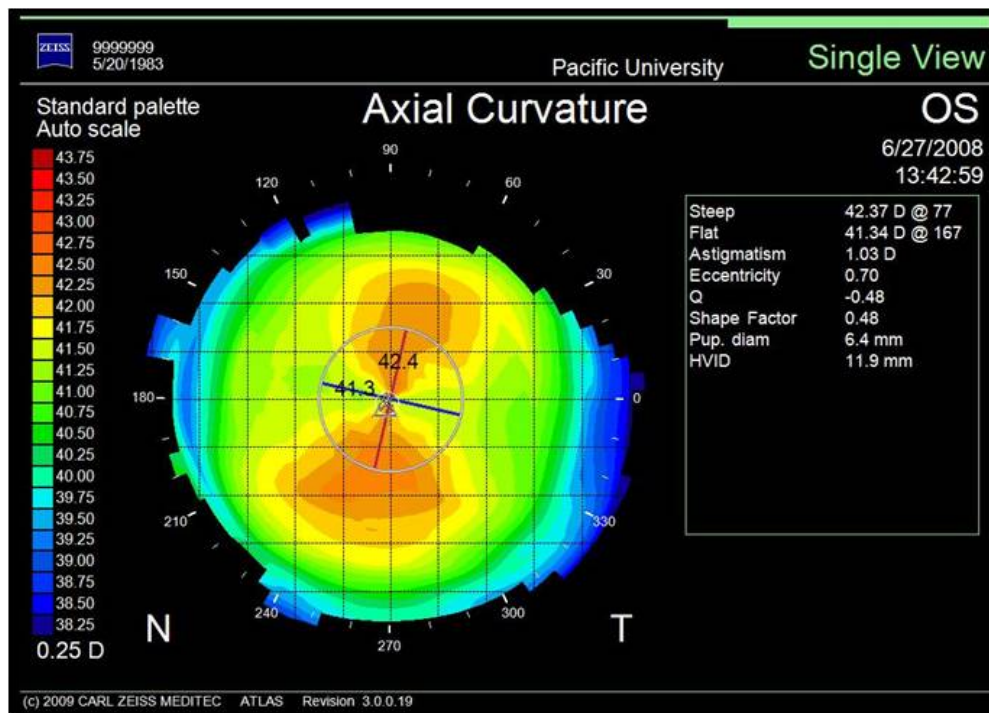


Figure 2: Approximately 1.00 D WTR cornea

By manipulating the base curve within the software, a spherical base curve of 0.50 D (~0.10 mm) steeper than the flattest keratometry readings can achieve an ideal fluorescein pattern with 20 microns of central clearance, landing at 3 and 9 o'clock with a vertical channel of clearance to promote unobstructed vertical movement (Figure 3).

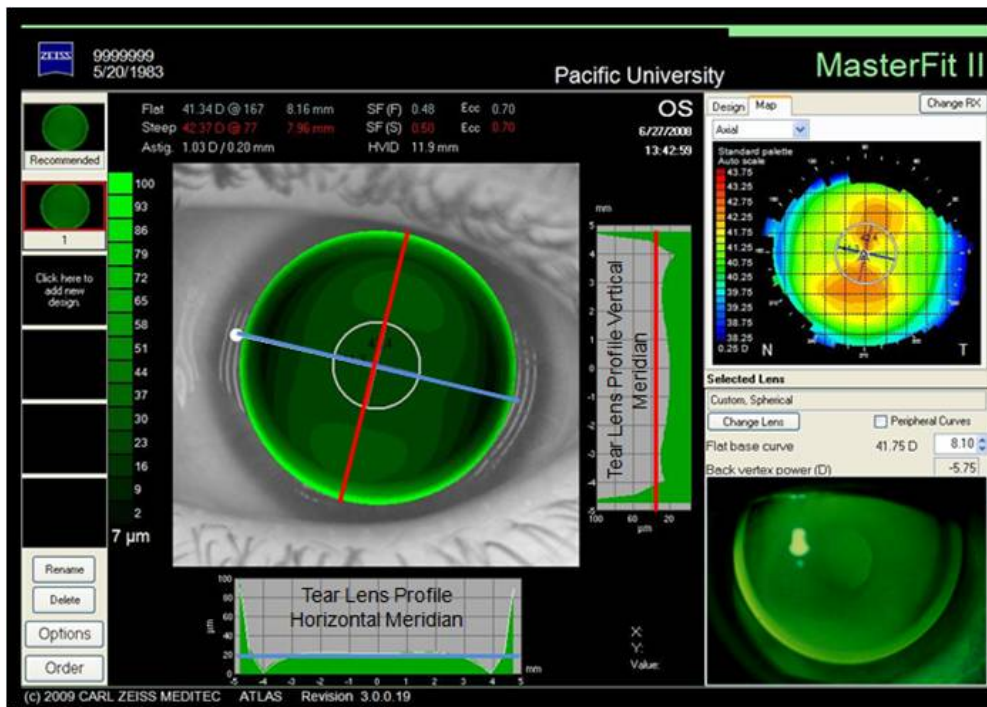


Figure 3: A 41.75 D (8.08 mm) base curve achieved a theoretical fluorescein pattern with 20 microns central clearance (blue bar) and a channel of less than 40 microns clearance in the vertical meridian (red bar). The photo on the lower right shows the actual fluorescein pattern.

When the change in corneal curvature exceeds 1.50 D (~0.30 mm), a toric fitting relationship may need to be considered. A spherical lens on a toric cornea can lead to poor vision and comfort, lens flexure and corneal molding. In Figure 4, the corneal astigmatism is 2.97 D (~0.60 mm) WTR. If we place a spherical lens on this eye, we achieve alignment at 3 and 9 o'clock (20 microns), but the vertical clearance is excessive (>40 microns) (Figure 5). This will lead to lens rocking on the flat meridian and patient discomfort.

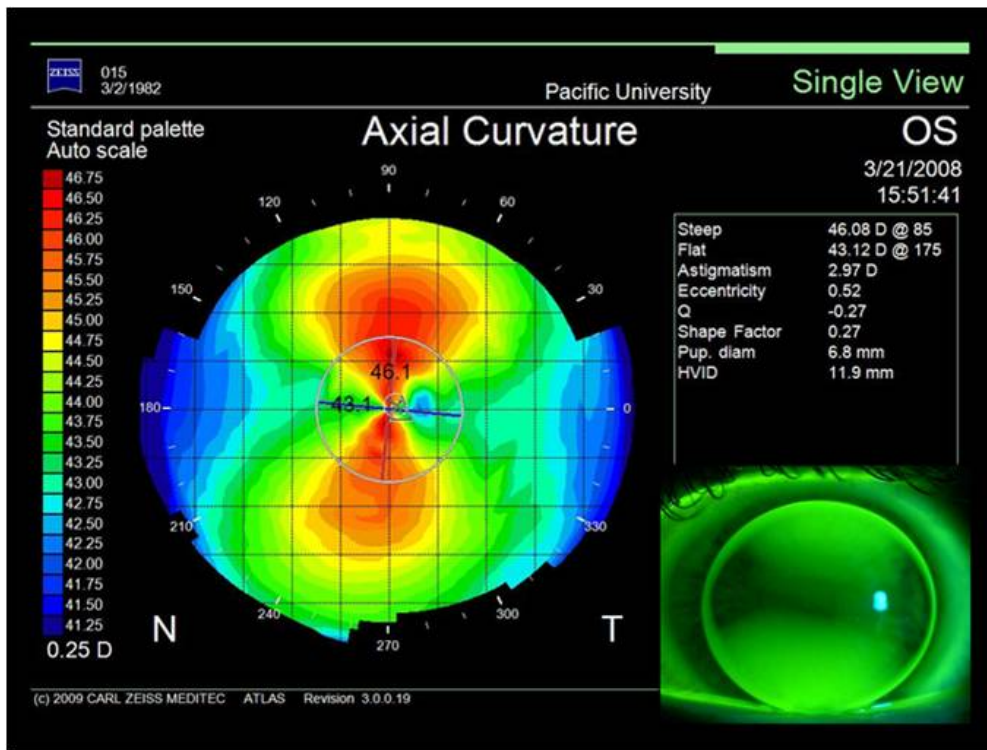


Figure 4: A highly toric cornea with a spherical base curve (R)GP. Note the thinning of sodium fluorescein in the horizontal meridian and excessive sodium fluorescein pooling in the 6 and 12 o'clock position.

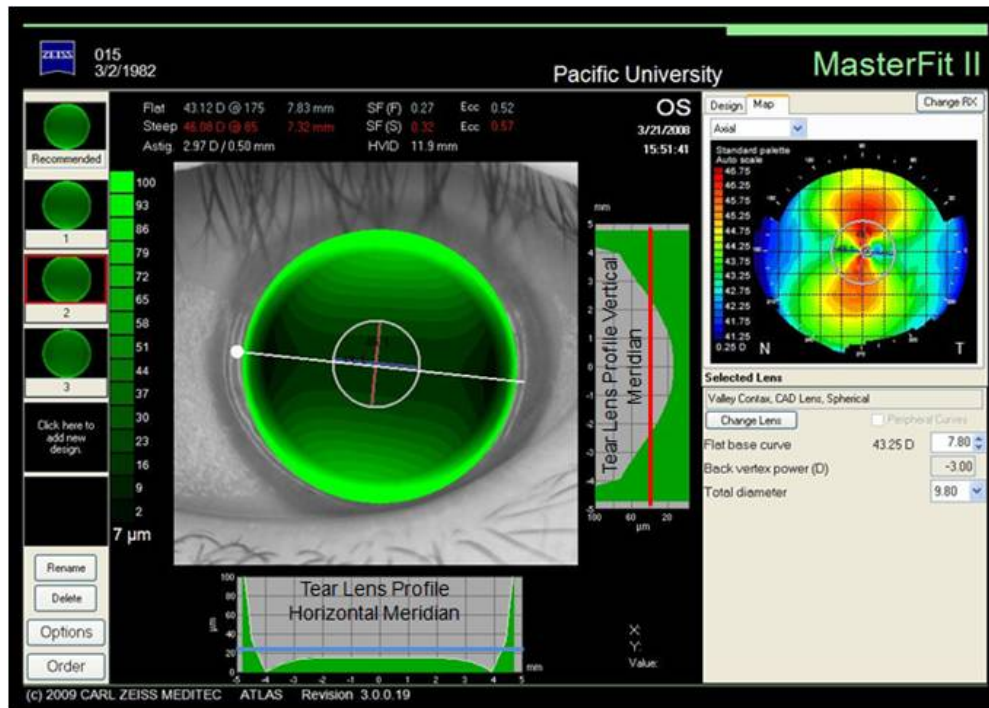


Figure 5: The theoretical tear lens profile in the horizontal meridian achieves 20 microns of clearance while the vertical meridian has greater than the ideal 40 microns.

By designing a toric contact lens, we can maintain the flat meridian base curve horizontally while creating a more appropriate lens-to-cornea relationship vertically. In Figure 6, a lens base curve of 43.25 D (7.80 mm) in the flat meridian and 44.75 D (7.54 mm) in the steep meridian achieves 20 microns of central clearance (vaults the apex) and approximately 40 microns of vertical clearance (unobstructed vertical movement). Using the software, the base curve of the lens can be manipulated independently to achieve the three fit factors. The software can also calculate the power of the contact lens, compensating for base curve and tear lens.

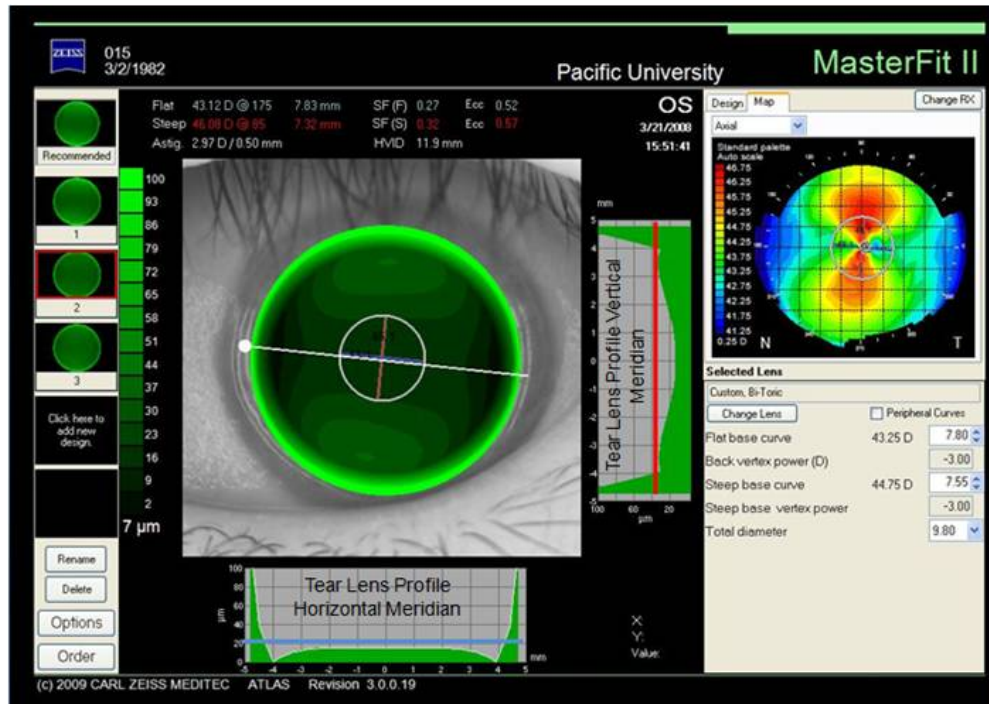


Figure 6: A toric lens provides an apical clearance of 20 microns and a fluorescein clearance of less than 40 microns at the 6 and 12 o'clock positions.

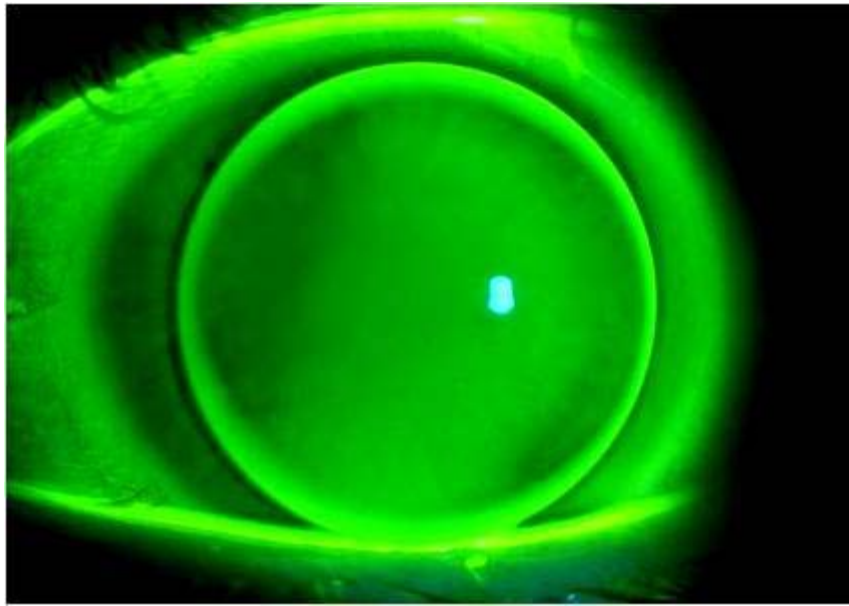
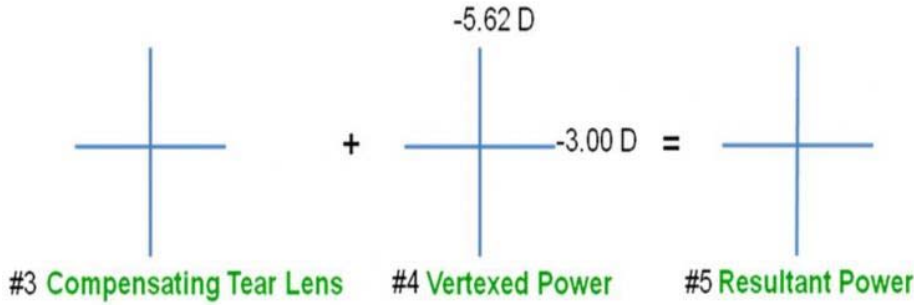
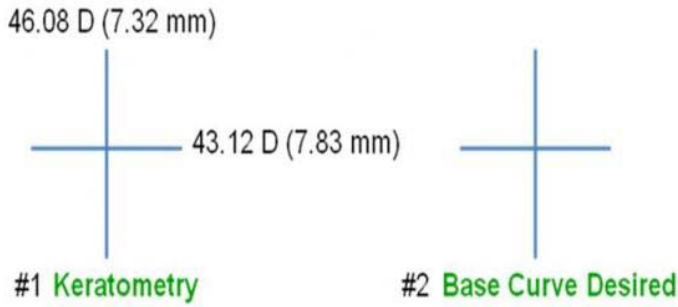


Figure 7: The toric (R)GP lens fluorescein pattern looks identical to that of a spherical lens on a $\sim 1.00D$ (~ 0.20 mm) WTR cornea.

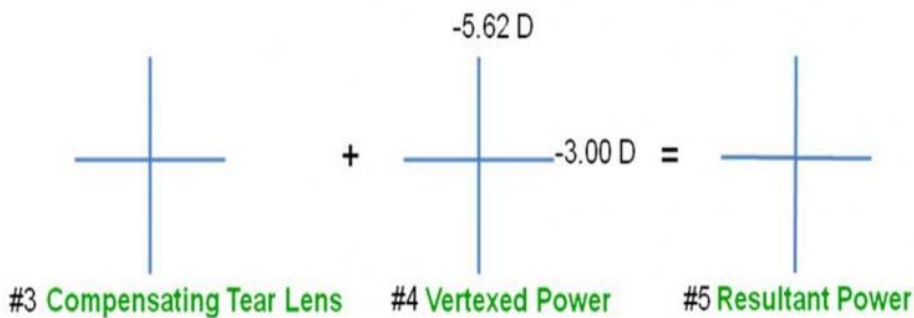
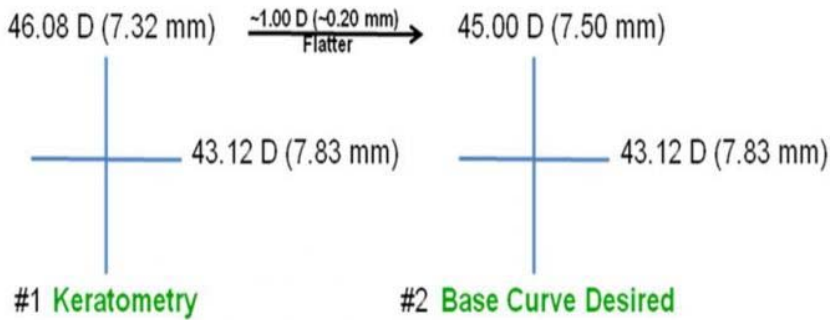
All topographers have limitations in the assumptions made with the actual lens fit. It is always important to place the lens on-eye (Figure 7), as each patient has unique factors such as lid position or tear film composition that play a significant role in the lens-to-cornea interaction.

Empirical Design

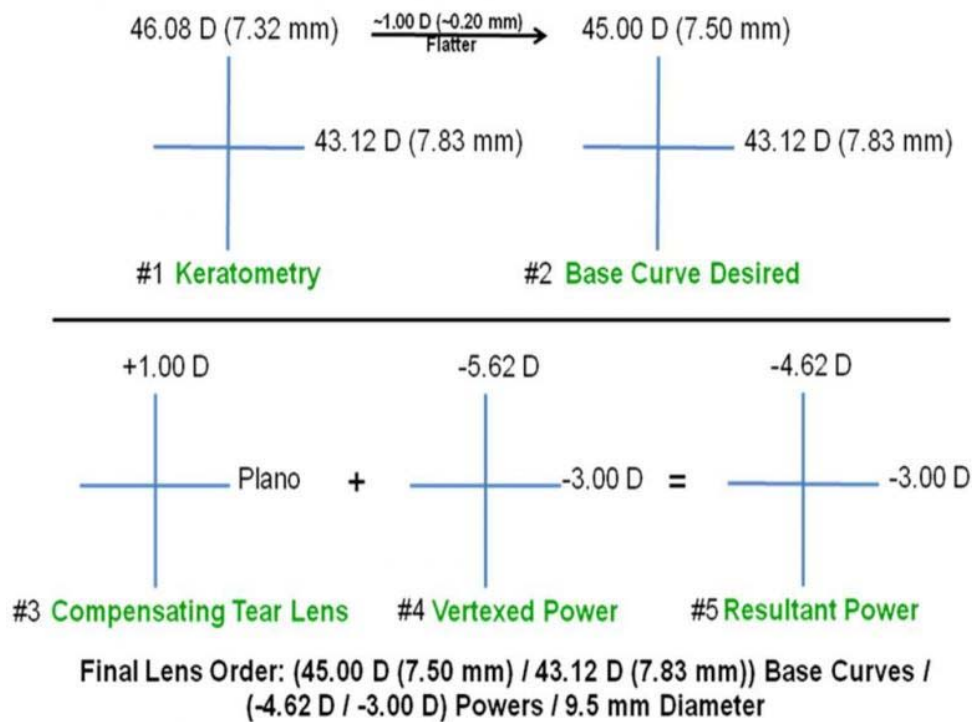
Without the topographer software, a toric (R)GP lens prescription can be achieved by placing the information onto five optical crosses and following the same three fit factors. Using the simulated keratometric readings from Figure 4 (43.12 D [7.83 mm] @ 175 / 46.08 D [7.32 mm] @ 085) and a spectacle prescription of -3.00 -3.00 x 180, we can determine a toric (R)GP contact lens for our patient.



Place the keratometry readings and vertexed spectacle power on their respective optical crosses. Next, determine the desired base curve by fitting ~1.00D (~0.20 mm) flatter than the keratometry reading in the vertical meridian and “on-K” in the horizontal meridian. This will help to achieve landing in the horizontal meridian, unobstructed vertical movement in the vertical meridian and an optimal ~1.00D (~0.20 mm) WTR pattern.



The Compensating Tear Lens applies SAM FAP (Steeper Add Minus, Flatter Add Plus) in the vertical meridian because the vertical meridian is ~1.00 D (~0.20 mm) flatter than the vertical keratometric reading. Finally, we vertex the spectacle prescription to the plane of the cornea and add the bottom row of optical crosses to establish the Resultant Power.



The overall diameter of the contact lens is generally ordered as 9.5 mm for an average cornea. This technique provides a great starting point for initial lens selection and in many cases is the final lens prescription. A toric design for a greater than 1.50 D (~0.30 mm) against-the-rule cornea can also be designed with either of the above methods, using the same fit factors, to achieve an optimal fit.

Closing Remarks

The two techniques for determining toric (R)GP contact lens parameters for the patient with astigmatism yielded similar results. Managing high astigmatism in any practice takes practice, but by mixing technology and a step-by step fitting approach, the art becomes a science.

Reference

1. Efron Nathan. Contact Lens Practice 2nd Edition. Chapter 2 The Anterior Eye. Butterworth-Heinemann, 2010



Beth Kinoshita
OD FAAO

Forest Grove OR United States

Beth is an Assistant Professor and serves as the Chief of Contact Lens Services at Pacific University College of Optometry.

She is a graduate of Southern California College of Optometry and of the Cornea and Contact Lens Residency Program at Pacific University.

She is also a Fellow of the American Academy of Optometry and has published and lectured on topics related to specialty contact lens design and prescribing.

I-site
Amsterdam
Netherlands
i-site@netherlens.com

[close](#)



- ■
- ■
- ■