Spherical versus Dual Axis Orthokeratology Lenses

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Introduction

Orthokeratology (OrthoK) contact lenses reshape the surface of the cornea to provide temporary correction of refractive error (RE). The base curve (BC) of the lens provides a central "push" force in hydraulic pressure, and the reverse curve or return zone depth (RZD) provides a mid-peripheral "pull" force to achieve treatment.[1]

Purpose

The following case details an OrthoK patient with low astigmatic RE yet with mild-moderate corneal toricity and elevation difference between the two principle meridians. This patient was initially fit in an OrthoK lens with a spherical, or symmetric, RZD (Paragon CRT) followed by a lens with a 50μm difference in RZD1/RZD2 (Paragon CRT Dual Axis). This case demonstrates the value of fitting dual depth lenses on patients with low astigmatic RE in order to increase efficacy of corneal reshaping and highlights the importance of evaluating corneal toricity when fitting OrthoK lenses.

Case Presentation

An 11 year old Asian female presented for OrthoK evaluation with a history of atropine use for myopia control.

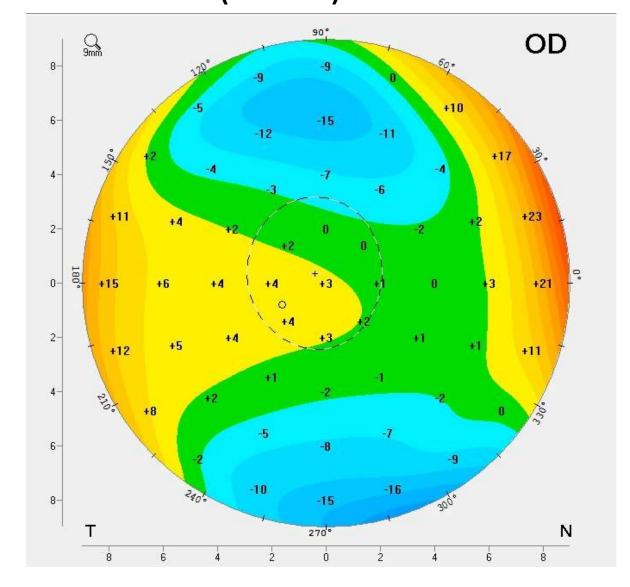|	OD	OS
Initial RE	-3.00 -0.50 x 160	-3.25 -0.50 x 170
Corneal Toricity	1.1 D WTR	1.2 D WTR
Avg Elevation Δ at a 8mm chord	30 μm	27.5 μm

Assessment: Compound myopic astigmatism OD, OS
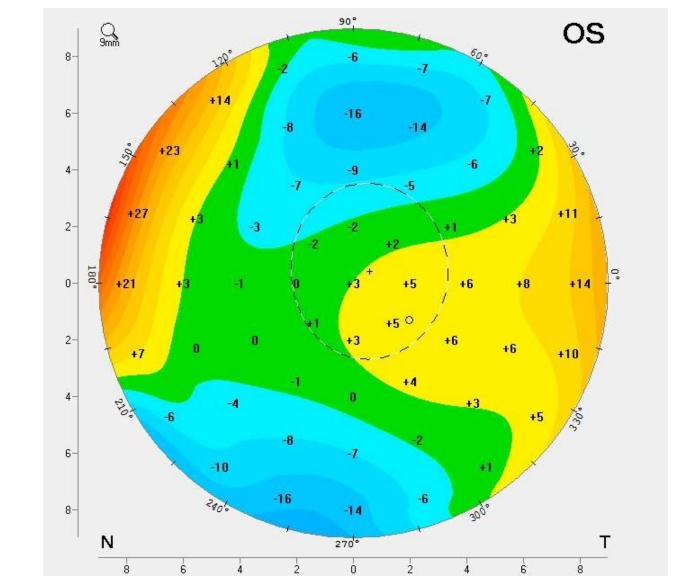**Plan:** Fit in spherical CRT based on manufacturer's slide rule recommendations
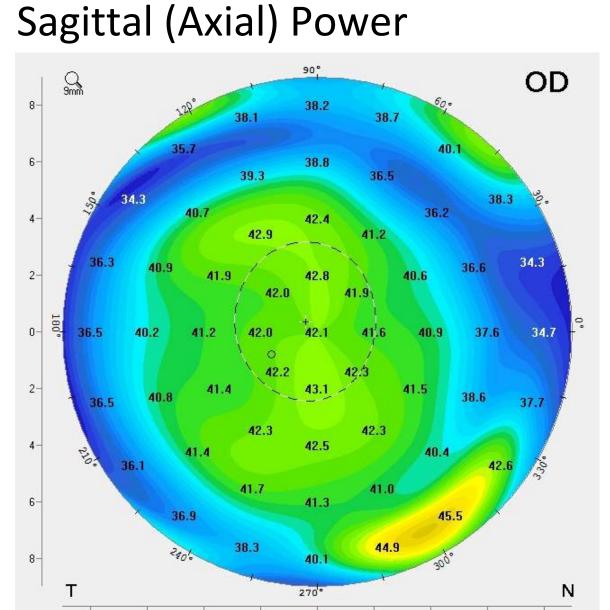**Initial Spherical CRT Lens:**
OD 8.8 BC/.525 RZD/-31 LZA/10.5 DIA/+0.50
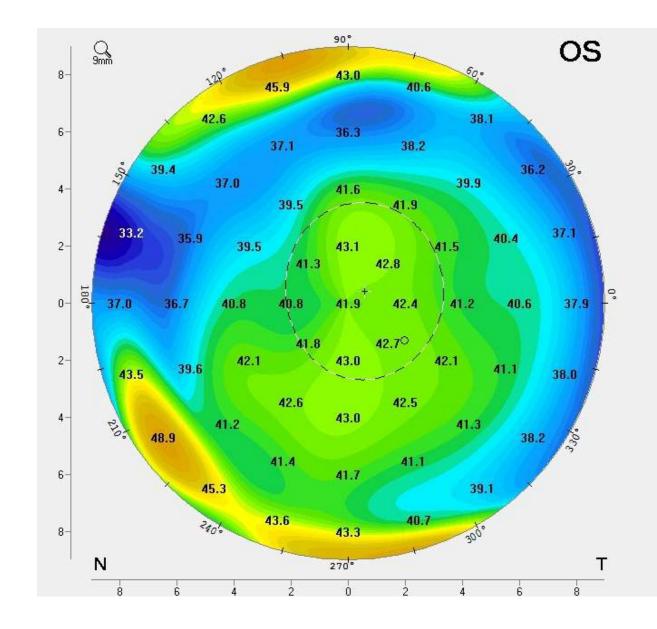**OS 8.9 BC/.500 RZD/-31 LZA/11.0 DIA/+0.50.**

Oculus Pentacam Topography
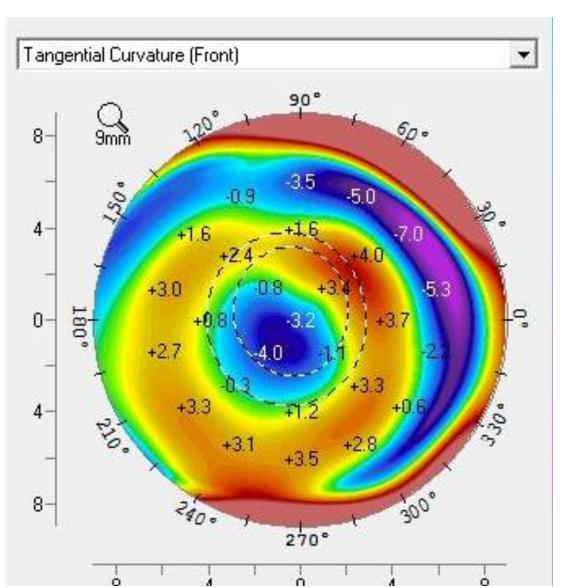Elevation (Front)

Sagittal (Axial) Power
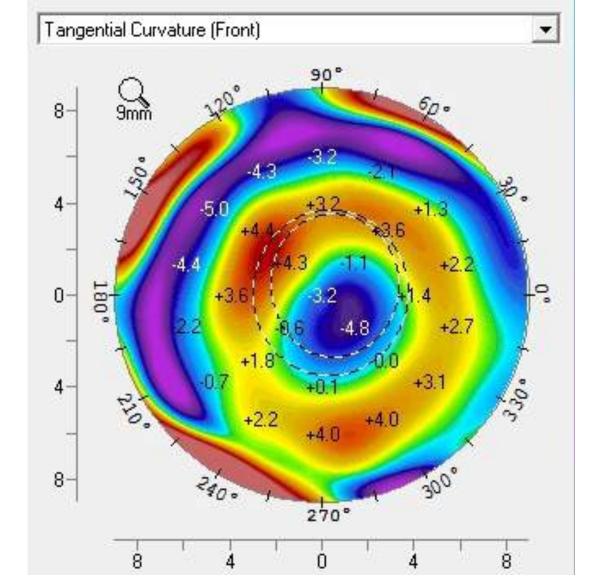

Case Presentation

Follow-up, 2 weeks of wear (Spherical CRT):
VA (sc): 20/20- OD, OS with complaints of blur
Manifest Refraction: -0.50 OD, -1.00 OS
Topography: Mid-peripheral ring somewhat incomplete with small treatment zone

Plan: Re-fit in CRT Dual Axis lenses in hopes of achieving a more complete treatment zone and mid-peripheral alignment
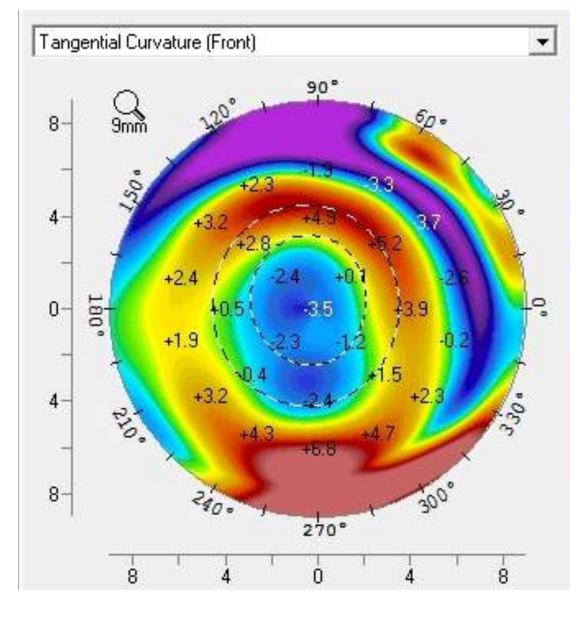**CRT Dual Axis #1:**
OD 8.8 BC/.525/.575 RZD/-31 LZA/10.5 DIA/+0.50
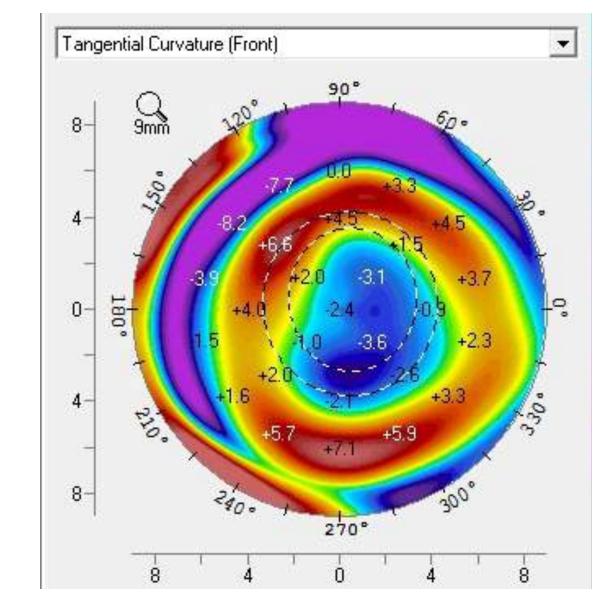**OS 8.9 BC/.500/.550 RZD/-31 LZA/10.5 DIA/+0.50**

Follow-up, 1 week of wear (CRT Dual Axis #1):
VA (sc): 20/20 OD, OS with no subjective complaints
Manifest refraction: Plano OD, OS
Topography: Mid-peripheral ring more complete with a larger treatment zone
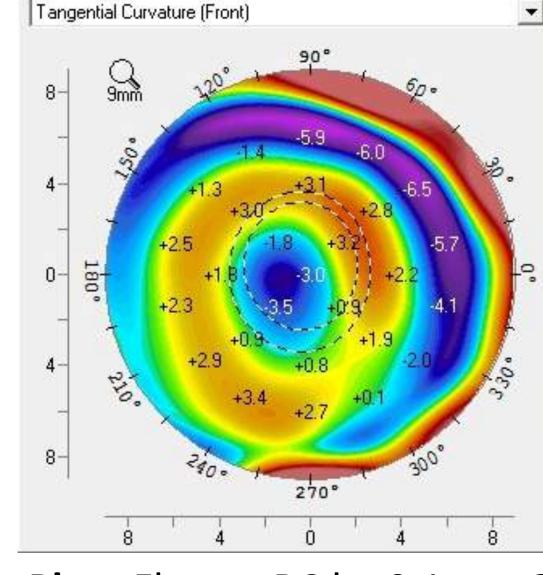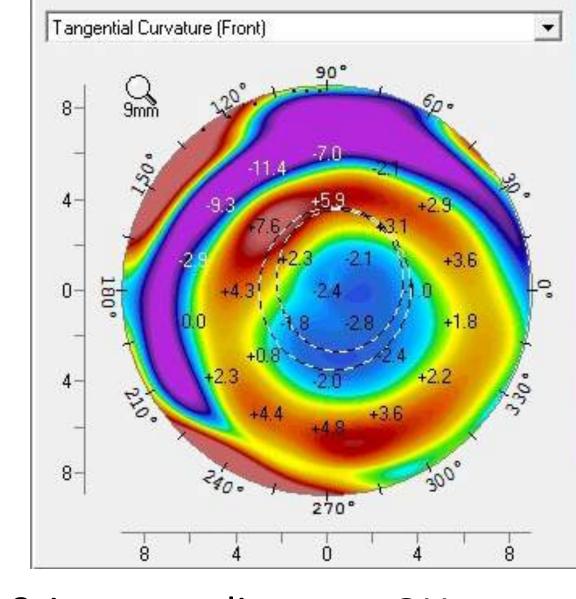

Follow-up, 1 month of wear (CRT Dual Axis #1):
CC: Blurred vision at end of day
VA (sc): 20/20^{-2} OD, 20/20- OS
Manifest refraction: Plano OD, OS
Topography: Small treatment zone OD, Adequate treatment OS

Plan: Flatten BC by 0.1mm OU & increase diameter OU to increase treatment and improve centration
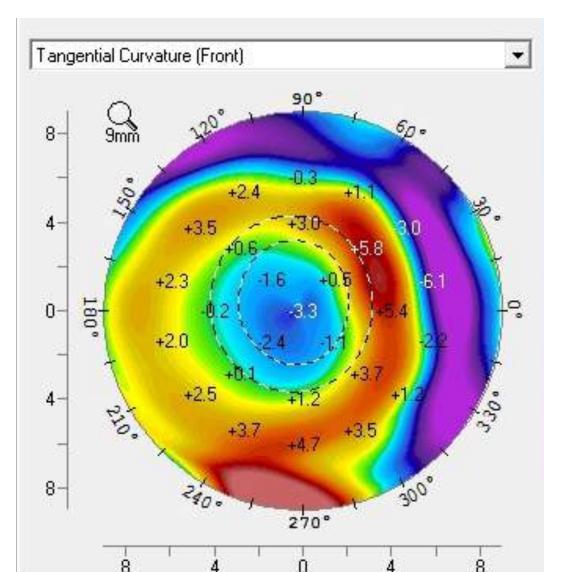**CRT Dual Axis #2:**
OD 8.9 BC/.525/.575 RZD/-31 LZA/11.0 DIA/+0.50
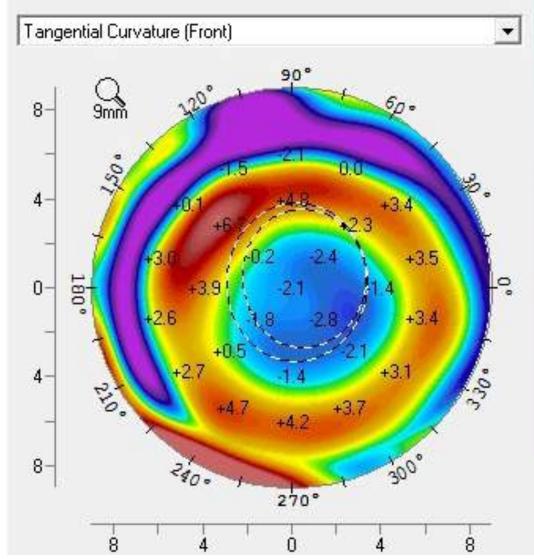**OS 9.0 BC/.500/.550 RZD/-31 LZA/11.0 DIA/+0.50**

Case Presentation

Follow-up, 1 month of wear (CRT Dual Axis #2):
VA (sc): 20/20- OD, 20/20- OS with no subjective complaints
Topography: Complete mid-peripheral ring with large treatment zone
Plan: Continue wear. Return in 3 months for follow up.

Discussion

The mechanism of OrthoK works through hydraulic pressure to create a semi-closed compartment in the post-lens tear film. The tear distribution in a spherical CRT lens design is uneven on a toric cornea due to the fact that the spherical OrthoK lens may be unable to maintain a semi-closed tear compartment, leading to reduced efficacy.

A well-aligned, complete mid-peripheral ring is important as it is suggested that the mid-peripheral steepening causes the myopic peripheral defocus that reduces axial length elongation.[2]

Therefore even with mild-moderate corneal toricity, a Dual Axis CRT fit may be beneficial for increased efficacy of myopia control. The following chart may serve as a guideline for fitting dual depth lenses.

Corneal Toricity	RZD Difference
0.75-1.25 DC	50μm RZD difference
1.25-1.75 DC	75μm RZD difference
>1.75 DC	100μm RZD difference

Conclusion

- CRT Dual Axis lenses are essential with moderate to high corneal toricity, but may also be beneficial for patients with mild corneal toricity or low refractive astigmatism.
- A 50 μm increase in the sagittal depth difference in RZD2 helped maximize reshaping efficacy in this patient with corneal toricity. The patient's subjective vision also improved with the complete mid-peripheral ring and larger treatment zone.

References

1. Sun Y, Wang L, Gao J, Yang M. "Influence of Overnight Orthokeratology on Corneal Surface Shape and Optical Quality." *J Ophthalmol.* 2017 Oct.
2. Kang P, Swarbrick H. "Time course of the effects of orthokeratology on peripheral refraction and corneal topography." *Ophthalmic Physiol Opt.* 2013 May; 33(3):277-82.

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