



# Fitting a Presbyopic Keratoconus Patient into Multifocal Gas Permeable Contact Lenses with an Aspheric Back Surface Design

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## INTRODUCTION

Corneal gas permeable (GP) lenses are a mainstay in providing adequate vision in keratoconus patients and reducing the distortions caused by an irregular cornea. When keratoconic GP wearers reach a presbyopic age, they are typically given reading glasses to wear over their single vision GPs or are fit into monovision GP lenses. As success in multifocal GP lenses is dependent on a stable and centered fit, practitioners tend to avoid fitting patients with keratoconus into multifocal GPs due to the natural tendency for the GP to center over the often decentered cone. The purpose of this case study is to determine if a keratoconic patient can achieve adequate distance and near vision using a multifocal GP contact lens with an aspheric back surface design.

## CASE

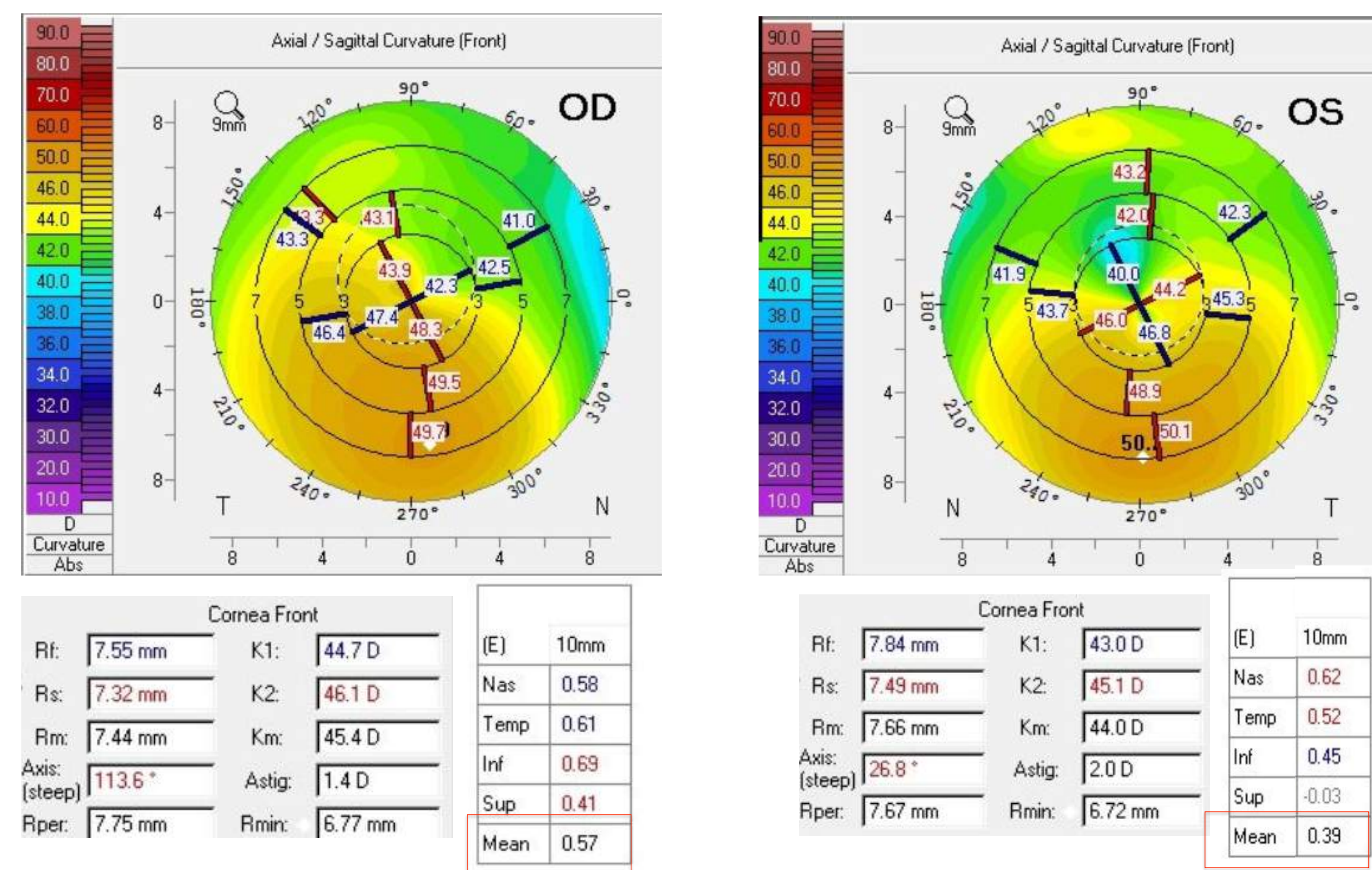
A 53 year old male with a history of keratoconus in both eyes presented for a contact lens evaluation. He was previously fit into single vision GP lenses. He reported difficulty reading at near with his current GP lenses and wanted to improve his near vision while remaining free from glasses.

### Manifest Refraction:

OD: -4.50 -1.25 x 55      VA: 20/40  
OS: -4.50 -1.00 x 100      VA: 20/30  
ADD: +1.50

Slit Lamp Findings: Corneal ectasia with apical thinning and mild haze OU

Figure 1: Pentacam Topographical Maps



Pentacam axial front curvature maps show an inferior oval cone OU. The mean corneal eccentricity within the central 10mm is 0.57 in the right eye and 0.39 in the left eye.

### Current GP lenses:

OD: -5.75 sph BC 7.40mm Diameter: 9.80mm VA: 20/30  
OS: -5.25 sph BC 7.60mm Diameter: 10.30mm VA: 20/40

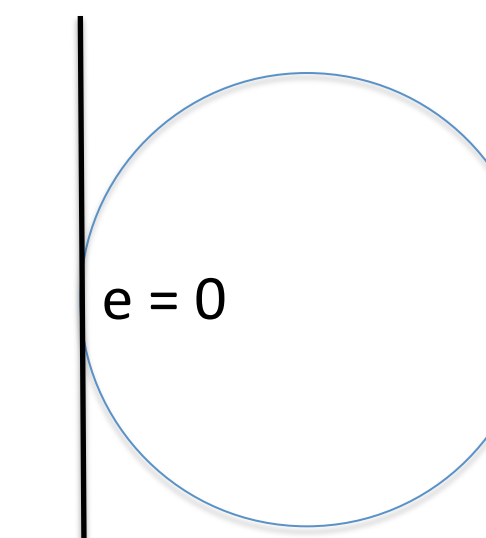
### Fit:

OD: interpalpebral fit, central touch, midperipheral clearance, slightly excessive edge lift, centered  
OS: interpalpebral fit, central touch, midperipheral alignment, good edge lift, centered

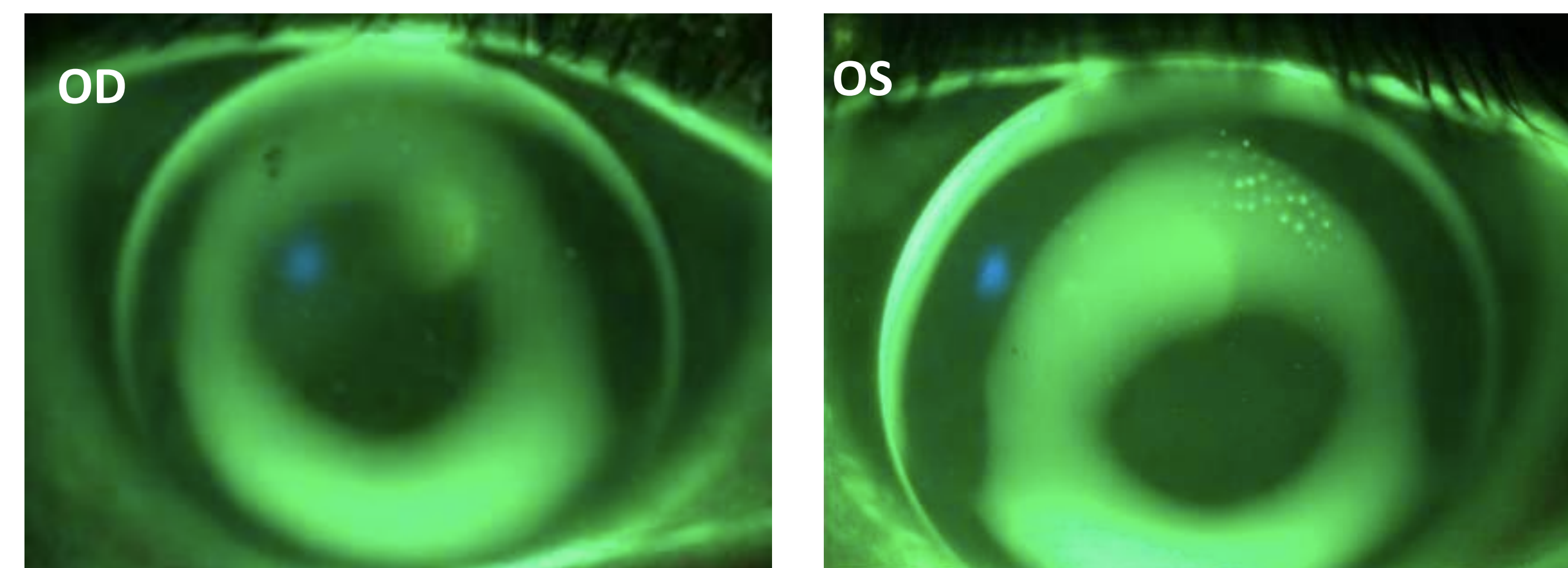
## Trial #1: Spherical base curve multifocal GP lenses

Multifocal GP lenses with a front aspheric surface and spherical base curve (Art Optical Renovation Multifocal) were ordered empirically based on the patient's keratometry and refraction.

	Power	Base Curve	Diameter
OD	-5.25 sph ADD +2.00	7.50mm	9.80mm
OS	-5.25 sph ADD +2.00	7.67mm	10.30mm



Model of a spherical base curve where eccentricity = 0



Fit: Central touch, paracentral pooling, good edge lift, with significant decentration inferior OU

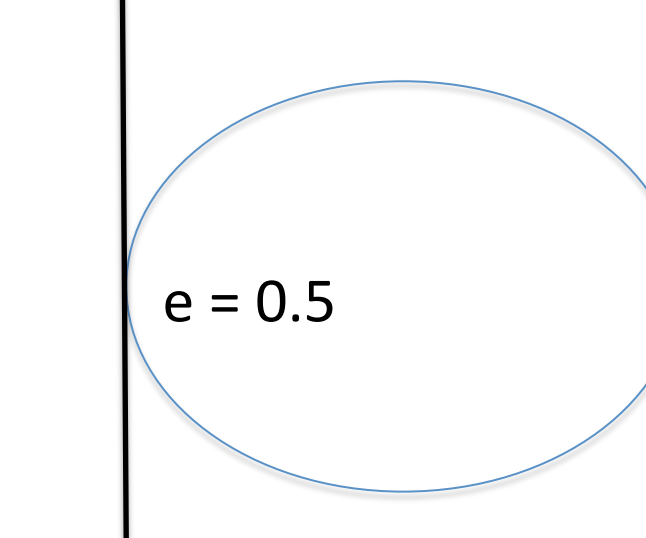
Distance Vision OU: 20/20  
Near Vision OU: 20/32  
Over-refraction: +0.50 sph OU improved vision at near subjectively

Result: Patient reported inadequate near vision.

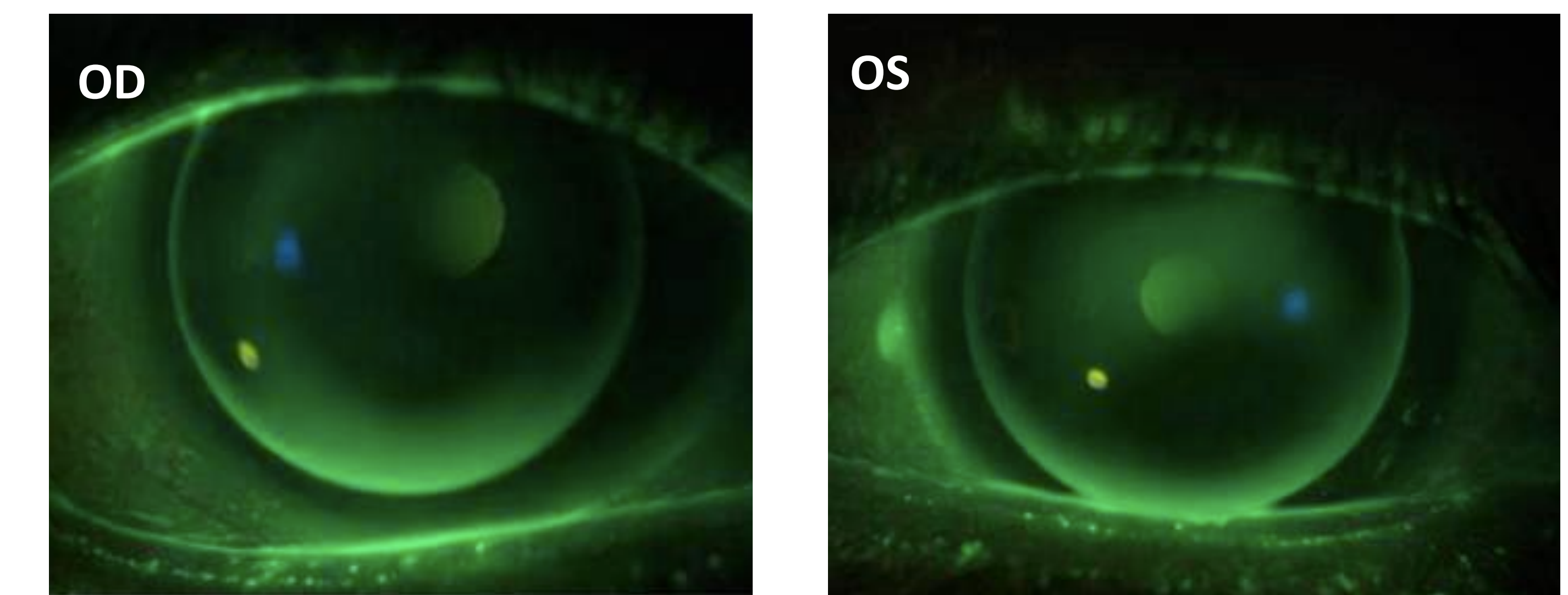
## Trial #2: Aspheric base curve multifocal GP lenses

Multifocal GP lenses with back surface asphericity of an eccentricity of 0.50 (Art Optical Renovation E Multifocal) were ordered. Diameter of each lens was reduced to improve centration, and the over-refraction incorporated

	Power	Base Curve	Diameter
OD	-5.00 sph ADD +2.25	7.41mm	9.60mm
OS	-5.25 sph ADD +2.25	7.52mm	10.00mm



Model of an aspheric base curve where eccentricity = 0.5



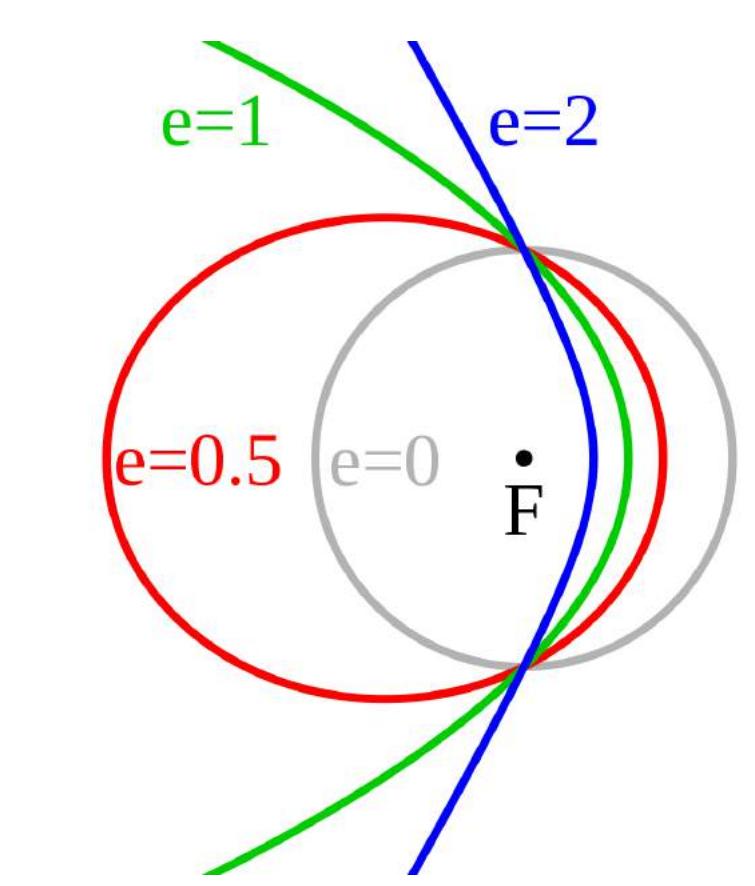
Fit: Central alignment, midperipheral alignment, good edge lift with good centration OU

Distance Vision OU: 20/25+2  
Near Vision OU: 20/20-  
Over-refraction: -0.25sph OD

Result: Improved centration, fitting alignment and near vision. Patient was very pleased with vision at distance and near.

## DISCUSSION

When it comes to fitting presbyopic patients with normal corneas into a simultaneous vision multifocal GP lens design, there can be challenges that arise. Lens centration and smooth translation into the near zone become key to achieving optimal near vision. When it comes to fitting a presbyopic patient with an irregular cornea, such as keratoconus, into these lenses, these challenges can be amplified. One variable to consider is the eccentricity of the cornea. The average eccentricity of a normal cornea is approximately 0.4-0.6. In patients with keratoconus, eccentricity of the cornea can be 0.80 or higher. Keratoconus patients may be more challenging to fit with a spherical base curve due to the disparity between the higher eccentricity of the cornea and a spherical ( $e = 0$ ) contact lens optic zone, leading to poor alignment, centration and stability. It is also hypothesized that a cornea with a higher eccentricity will experience midperipheral binding with a spherical lens making it difficult to translate efficiently. A lens with a back aspheric surface can allow for improved alignment between a keratoconic cornea and the GP lens leading to improved translation and enhanced near power effect.



### Model of curves with varying eccentricities.

A sphere has an eccentricity of 0.  
A parabola has an eccentricity of 1.  
A hyperbola has an eccentricity of 2.  
The average cornea has an eccentricity of 0.4-0.6.

## CONCLUSION

It is possible for keratoconus patients to successfully wear multifocal gas permeable contact lenses to achieve acceptable distance and near vision. Incorporating a back surface aspheric design can improve centration of the optic zone and facilitate a successful fit.

## REFERENCES

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- Heydarian S., Hashemi H., Shokrollahzadeh F., et al. The normal distribution of corneal eccentricity and its determinants in two rural areas of north and south of Iran. *J Curr Ophthalmol*. 2018;30(2):147-151. doi: 10.1016/j.joc.2017.11.006