

# Scientific deep dive: clinical results from in-vivo and in-vitro competitor analysis

Ramin Khoramnia, Grzegorz Łabuz, Gerd U. Auffarth

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The David J. Apple International Laboratory for Ocular Pathology  
Department of Ophthalmology  
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# IVCRC / DJ Apple Laboratory: Financial Disclosure 2018/2019

1stQ<sup>1,3</sup>  
Acufocus<sup>1,3</sup>  
Alcon<sup>1,2,3,4</sup>  
Alimera<sup>1,2,3</sup>  
Allergan<sup>2,3</sup>  
AMO/Johnson&Johnson<sup>1,2,3,4</sup>  
Anew<sup>1</sup>  
Bausch+Lomb<sup>2,3</sup>  
Bayer<sup>1,2,3</sup>  
Biotech<sup>1,3</sup>  
BVI<sup>3</sup>  
Carl Zeiss Meditec<sup>1,2,3</sup>  
Contamac<sup>1</sup>  
Glaukos<sup>1</sup>  
Hoya<sup>1,2,3</sup>  
Kowa<sup>1,2,3</sup>  
Novartis<sup>1,2,3</sup>  
Oculentis<sup>1,2,3</sup>  
Oculus<sup>1,2,3</sup>  
Ophtec<sup>3</sup>  
Physiol<sup>1,3</sup>  
Presbia<sup>2,3,4</sup>  
Rayner<sup>1,2,3</sup>  
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Santen<sup>1,2,3</sup>  
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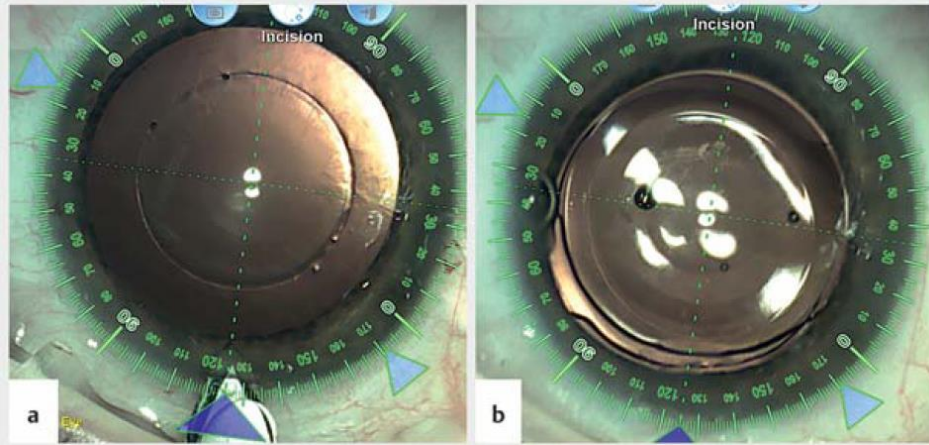


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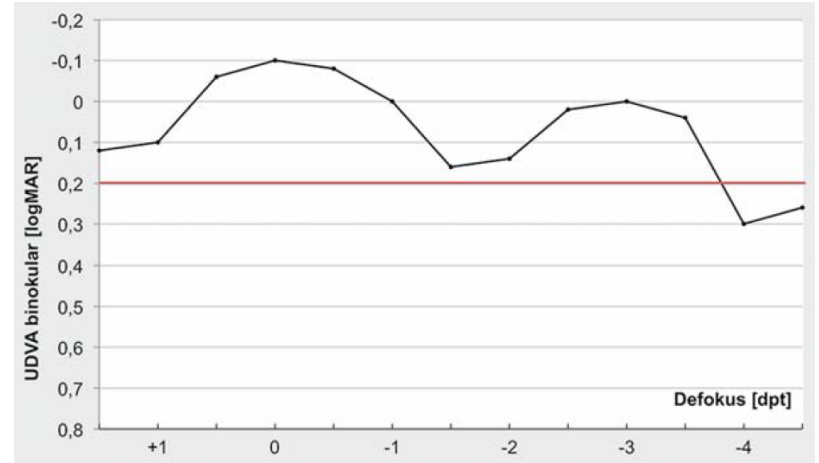
# Reversible Multifocality: Duet Procedure with bifocal Sulcoflex\*



► Tab. 1 Präoperative Visusdaten.

Auge	subjektive Refraktion	UDVA (dezimal)		CDVA (dezimal)		DCNVA (dezimal)	
rechts	-12,0/-1,75/93°	<0,05	<0,05	0,8 pp	0,8	0,8	0,8
links	-14,0/-1,25/80°	<0,05		0,8 pp		0,8 p	

UDVA: unkorrigierter Fernvisus, CDVA: korrigierter Fernvisus, DCNVA: fernkorrigierter Nahvisus



► Tab. 3 Postoperative Visusdaten.

Auge	subjektive Refraktion	UDVA (dezimal)		CDVA (dezimal)		DCNVA (dezimal)	
rechts	plan/-0,5/90°	0,63+	1,0	0,63++	1,0	0,8 pp	0,8
links	Gbn	0,8++		0,8++		0,8 p	

Gbn: Gläser bessern nicht, UDVA: unkorrigierter Fernvisus, CDVA: korrigierter Fernvisus, DCNVA: fernkorrigierter Nahvisus

\*Yildirim TM, Auffarth GU, Son HS, Mayer CS, Tandogan T, Khoramnia R. [Duet Procedure in High Myopia to Achieve Reversible Multifocality]. Klin Monbl Augenheilkd. 2019 [Epub ahead of print]

# Optical quality of trifocal IOL

**Originalien**

Ophthalmologie  
<https://doi.org/10.1007/s00347-017-0573-0>

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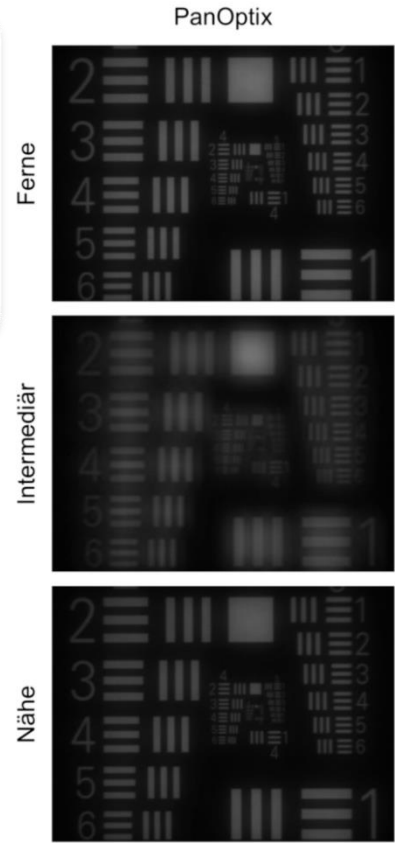
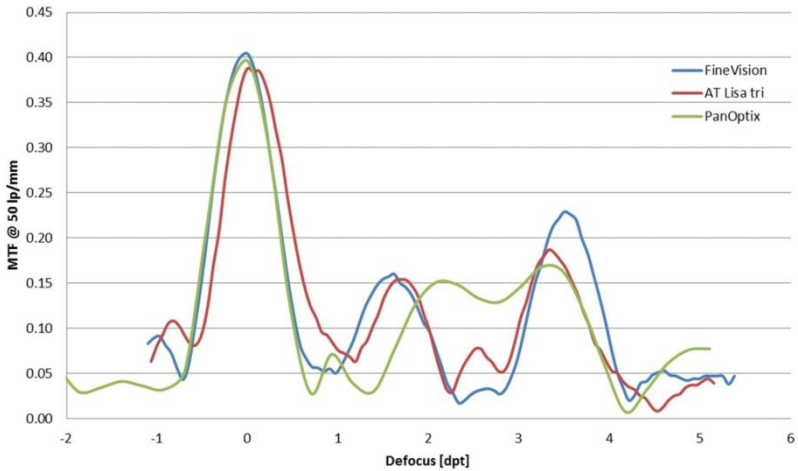
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**R. Khoramnia<sup>1</sup> · T. M. Yildirim<sup>1</sup> · T. Tandogan<sup>1</sup> · S. Liebing<sup>1</sup> · G. Labuz<sup>1</sup> · C. Y. Choi<sup>1,2</sup> · G. Auffarth<sup>1</sup>**

<sup>1</sup>David J Apple International Laboratory for Ocular Pathology and International Vision Correction Research Centre (IVCRC), Universitäts-Augenklinik Heidelberg, Heidelberg, Deutschland  
<sup>2</sup>Department of Ophthalmology, Kangbuk Samsung Hospital, Sungkyunkwan University, Seoul, Südkorea

**Optische Qualität dreier trifokaler Intraokularlinsenmodelle**

Vergleich an der optischen Bank

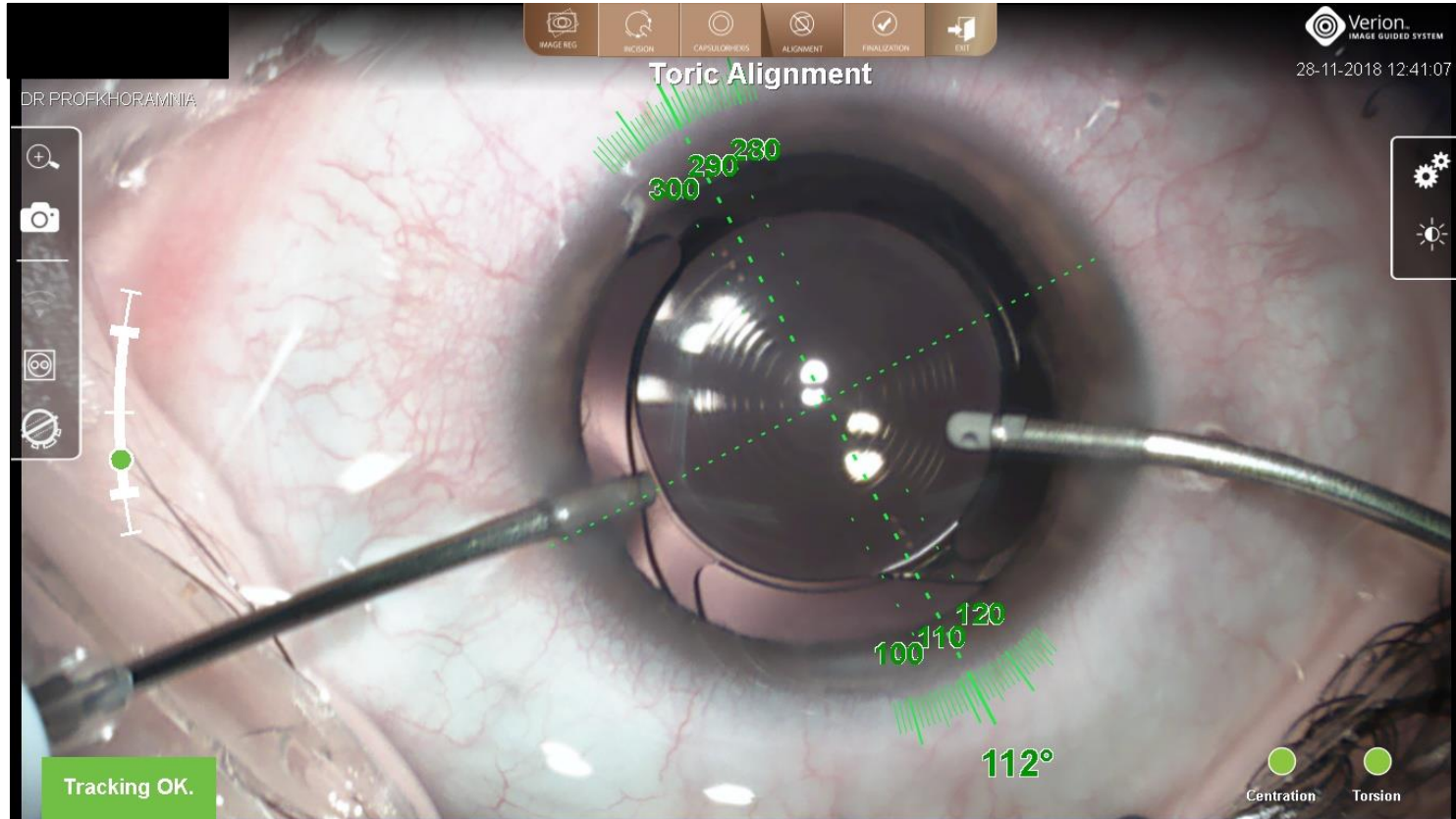


- The implantation of trifocal IOL into the capsular bag has become standard of care in the treatment of presbyopia.
- Trifocal supplementary IOLs can now also be used.

Khoramnia R, Yildirim TM, Tandogan T, et al. [Optical quality of three trifocal intraocular lens models : An optical bench comparison]. *Ophthalmologie*. 2017.



# Reversible Trifocality: DUET Procedure with Sulcoflex Trifocal



# Optical quality measurements

## Assessment of the optical quality of study IOLs



OptiSpheric IOL PRO 2,  
Trioptics, Germany

- 0 D Sulcoflex Trifocal (IOL703F, Rayner) and 20 D RayOne Aspheric (RAO600C, Rayner)
- 20 D RayOne Trifocal (RA0603F, Rayner)

### 2 against 1

- 20 D PanOptix (Alcon, USA)
- 20 D FineVision POD F (PhysIOL, Belgium)
- 20 D AT Lisa Tri (Carl Zeiss, Germany)

### Competitor analysis



# Light transmission: 2 against 1

The **light attenuation from surface reflections** was assessed by theoretical calculations of the reflection coefficients (**R**) based on Fresnel equations:

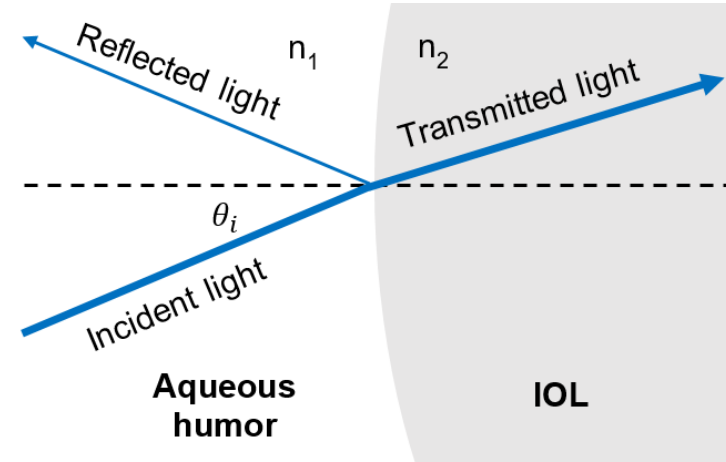
$$R_s = \left| \frac{n_1 \cos\theta_i - n_2 \sqrt{1 - \left(\frac{n_1}{n_2} \sin\theta_i\right)^2}}{n_1 \cos\theta_i + n_2 \sqrt{1 - \left(\frac{n_1}{n_2} \sin\theta_i\right)^2}} \right|^2$$

$$R = \frac{R_s + R_p}{2}$$

$$R_p = \left| \frac{n_1 \sqrt{1 - \left(\frac{n_1}{n_2} \sin\theta_i\right)^2} - n_2 \cos\theta_i}{n_1 \sqrt{1 - \left(\frac{n_1}{n_2} \sin\theta_i\right)^2} + n_2 \cos\theta_i} \right|^2$$

s = perpendicular polarization

p = parallel polarization



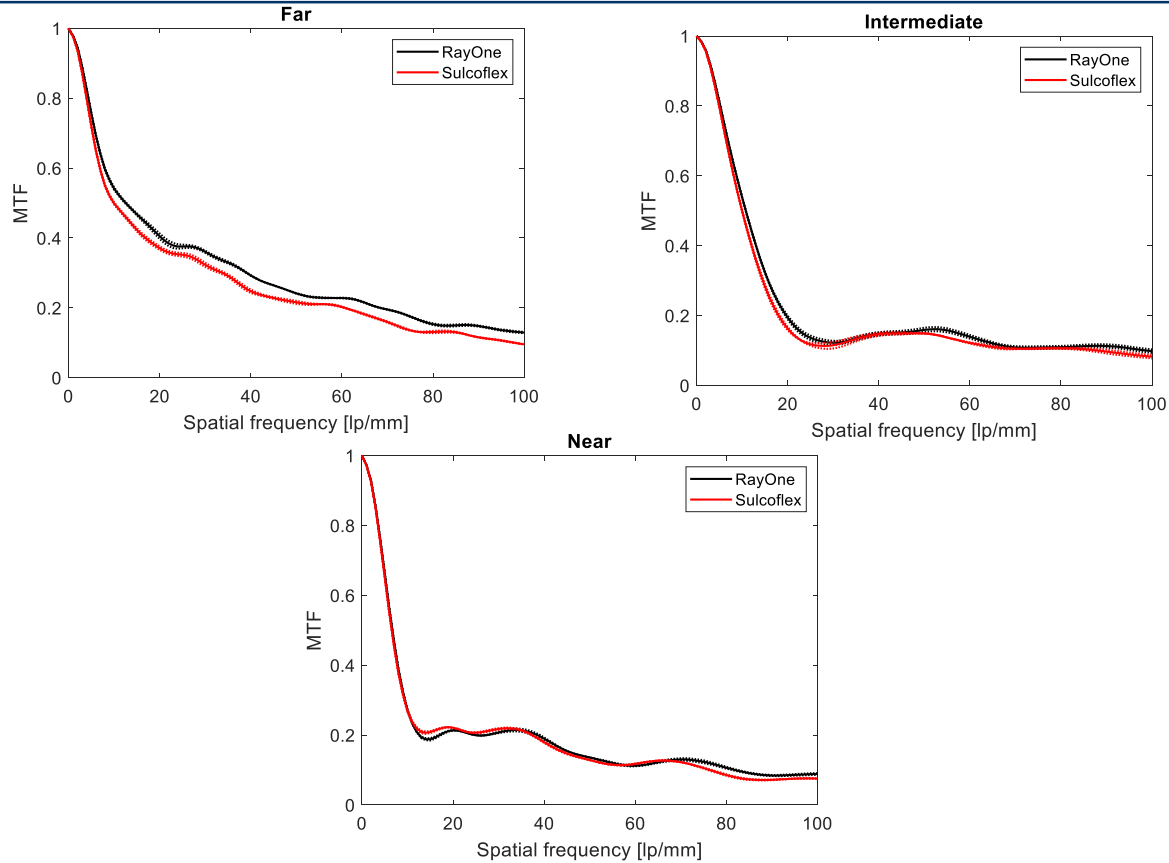
$$n_1 = 1.336; n_2 = 1.46$$

$$\theta_i = 0 \text{ to } 15 \text{ degrees}$$





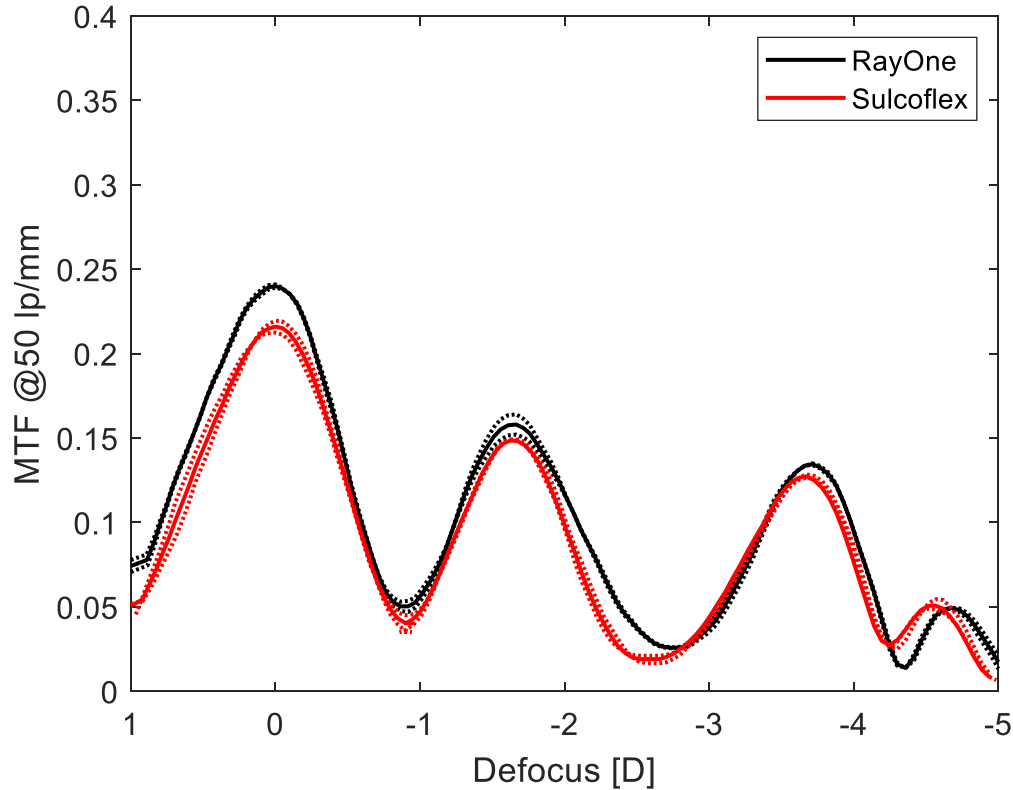
# MTF: 2 against 1





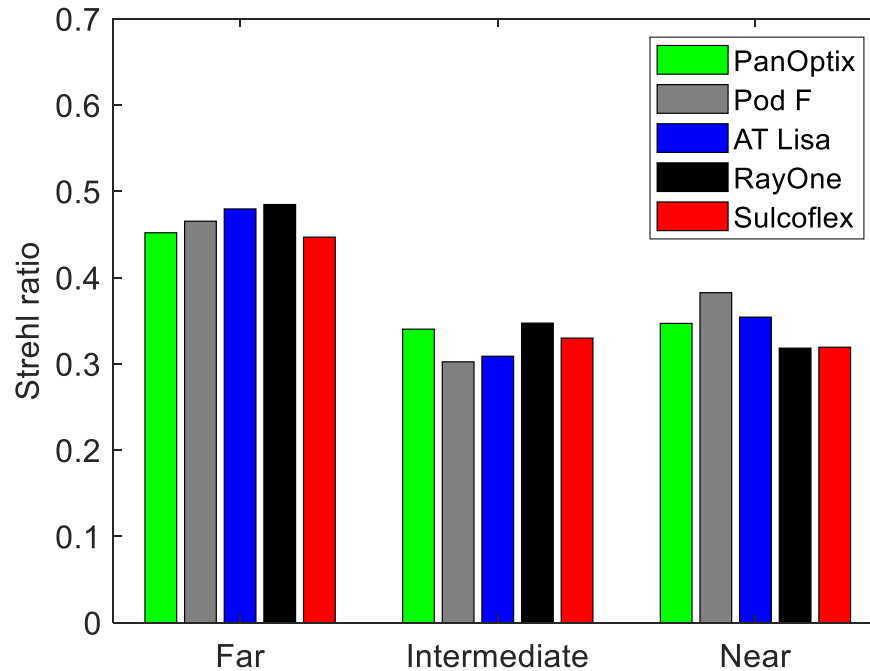


# Through focus MTF: 2 against 1



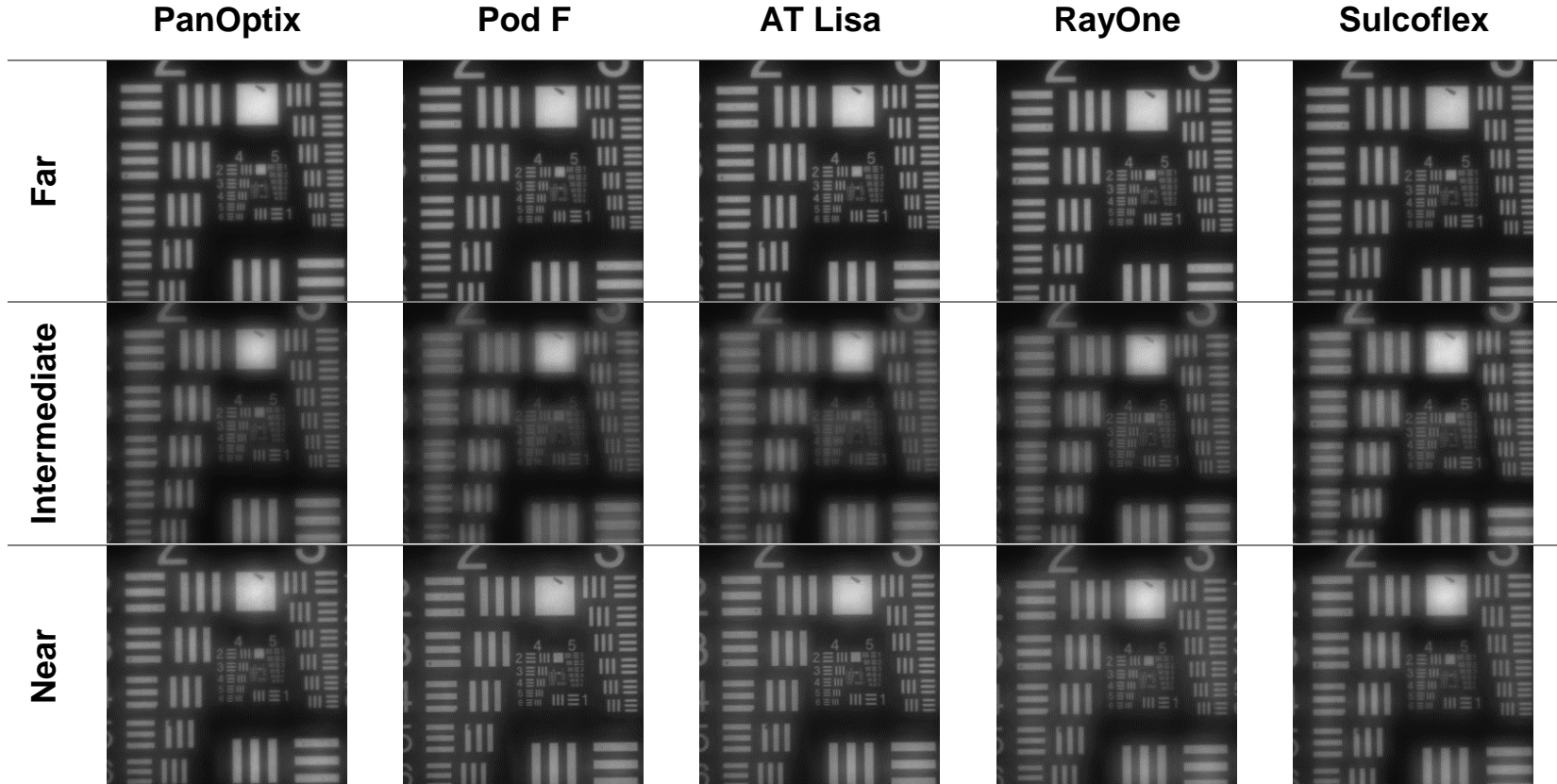


# Strehl Ratio: Competitor analysis





# USAF-Target:Competitor analysis





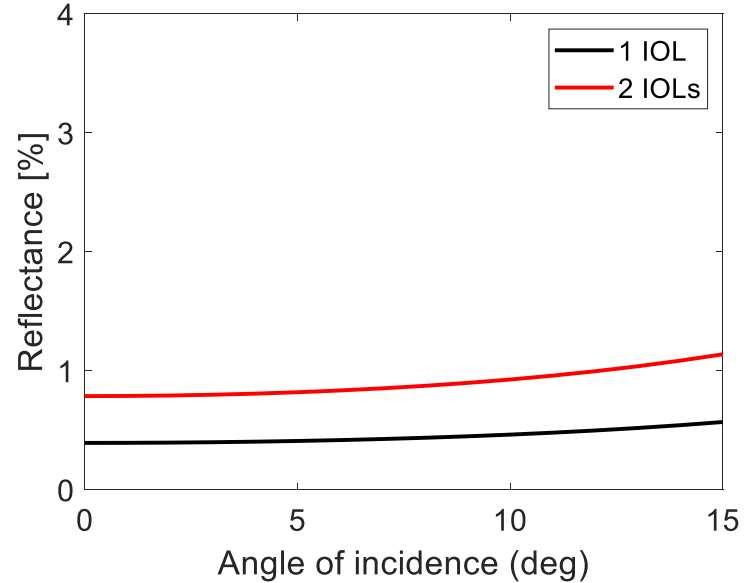
# Light transmission: 2 against 1

	<b>Reflectance</b>	<b>Transmission</b>
	<b>[%]</b>	<b>[%]*</b>
1 IOL <sup>±</sup>	0.4	99.6
2 IOLs <sup>†</sup>	0.8	99.2

\*Transmission = 100 – Reflectance

±RayOne monofocal

†RayOne monofocal and Sulcoflex



For comparison: **1 AcrySof IOL** with a refractive index of 1.55

Reflectance = **1.1%**  
Transmission = **98.9%**

# Conclusions

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- Combination of Sulcoflex Trifocal and RayOne Aspheric monofocal :
  - Good performance regarding the MTF in the far, intermediate and near focal point
  - comparable results to “standard” trifocal IOLs for capsular bag implantation
  - No disadvantages due to additional interfaces (e.g., no light loss)
- The polypseudophakic approach can be used as a reversible procedure for presbyopia treatment without affecting the optical quality.



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*Thank you!*



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