SPHERICAL ABERRATION INDUCTION AND DEPTH OF FOCUS WITH MULTIFOCAL FULLY SCLERAL CONTACT LENSES

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Purpose:

The purpose of this study was to evaluate the effect of different levels of induction of spherical aberration (SA) on depth of focus (DoF) with multifocal fully scleral contact lenses (MFSL) (Figure 1)

Lens	conic constant K1	
0	0	Circle
1	-0.1	
2	-0.2	
3	-0.3	
4	-0.4	
5	-0.5	Prolate ellipse
6	-0.6	
7	-0.7	
8	-0.8	
9	-0.9	
10	-1	Parabola
11	-1.1	
12	-1.2	
13	-1.3	
14	-1.4	
15	-1.5	Hyperbola
16	-1.6	
17	-1.7	
18	-1.8	
19	-1.9	
20	-2	

Figure 1.- Different types of conic constants and surface shapes simulated in the current study

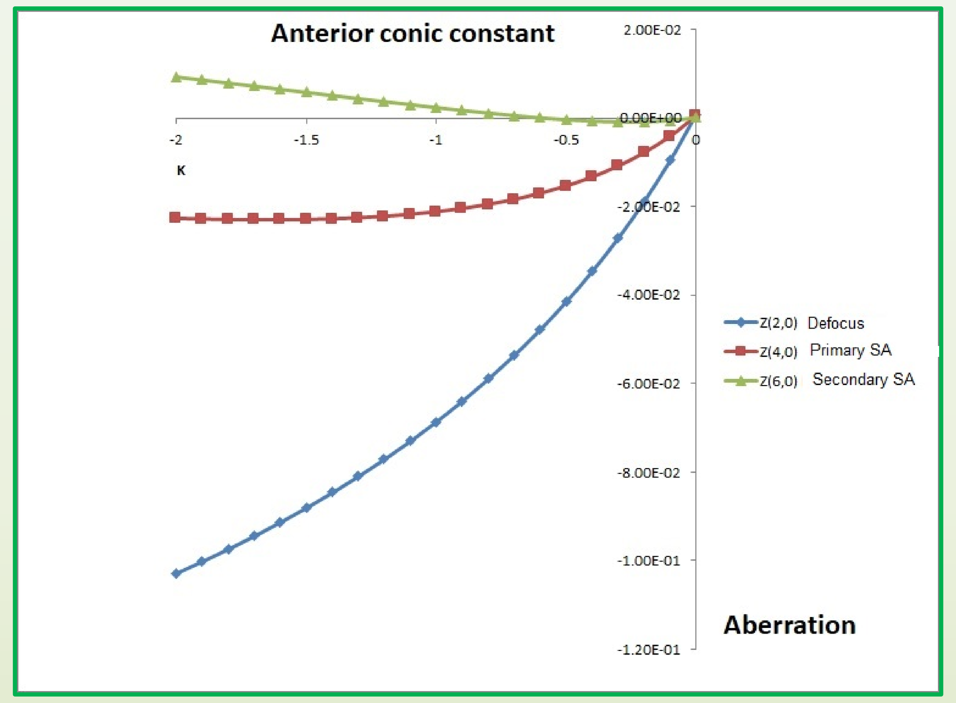

Figure 2.- Change in defocus, primary and secondary spherical aberration of a lens according to the conic constant of the anterior surface assuming a constant conic constant of -0.4 for the posterior surface

Methods:

- Optical simulations were performed using the optical design software OPTALIX
- A modified version of the Navarro eye model was used inducing three different levels of SA, 0.40, 0.00 and -0.20 µm
- MFSL were simulated considering a fixed conic constant of the posterior surface of -0.4 and a variable conic constant of the anterior surface (Figure 1) inducing different levels of SA (Figure 2)
- The modulation transfer function (MTF) was calculated for each level of SA considering the following variables:
  - 6-mm pupil
  - Optotype equivalent to visual acuity of 0.20 logMAR at distance
  - A push-up test is performed for simulating the MTF for different vergence levels (change spatial frequency with increasing vergence): from 0 to 3 D
  - Absence of tear film meniscus

Conclusions:

A customized geometry of the anterior surface of a MFSL according to the ocular SA and the patient's vergence demands is required for optimizing the DoF provided

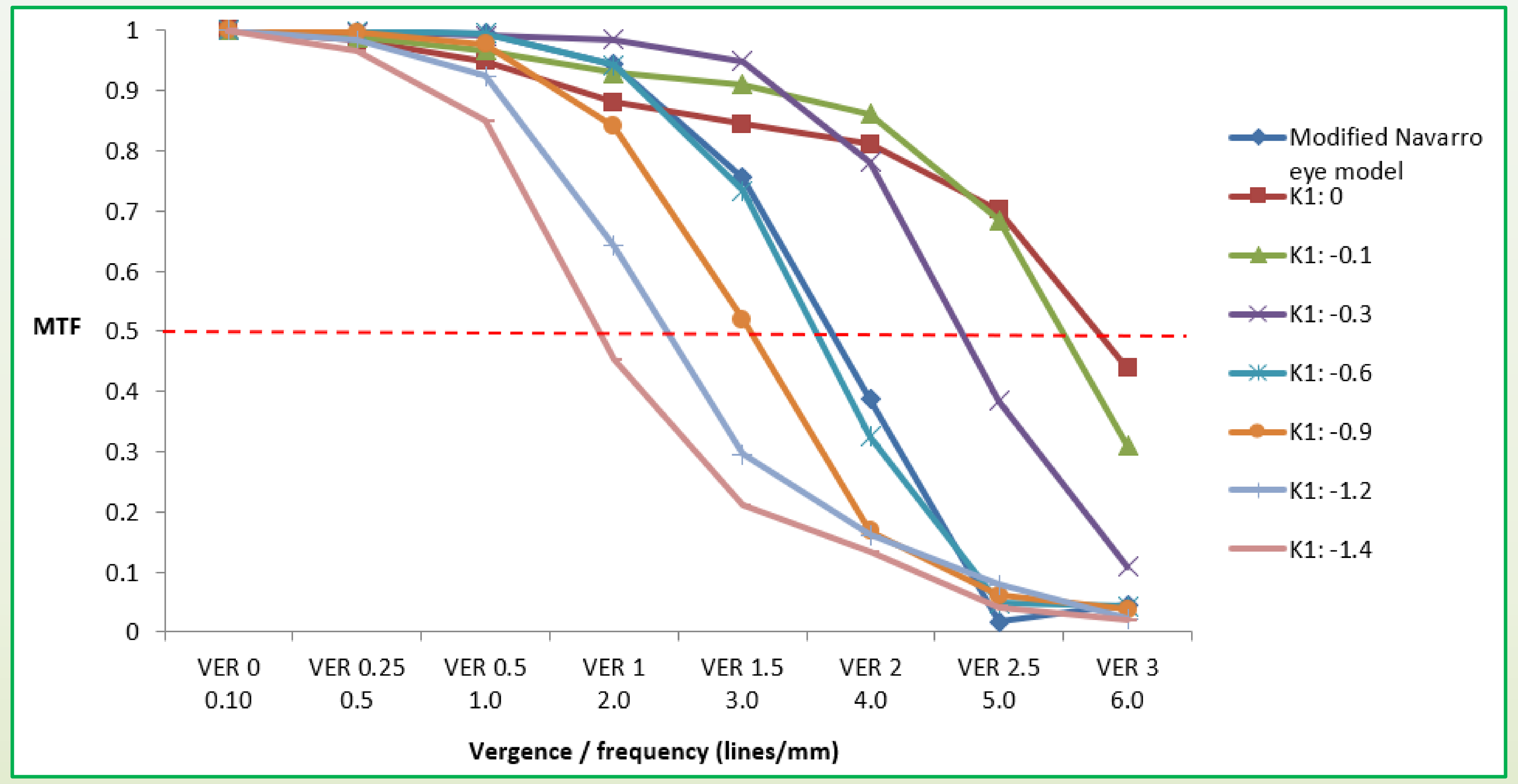

Figure 3.- MTF simulated for different levels of vergence and anterior conic constant in the eye with SA of 0.0 µm

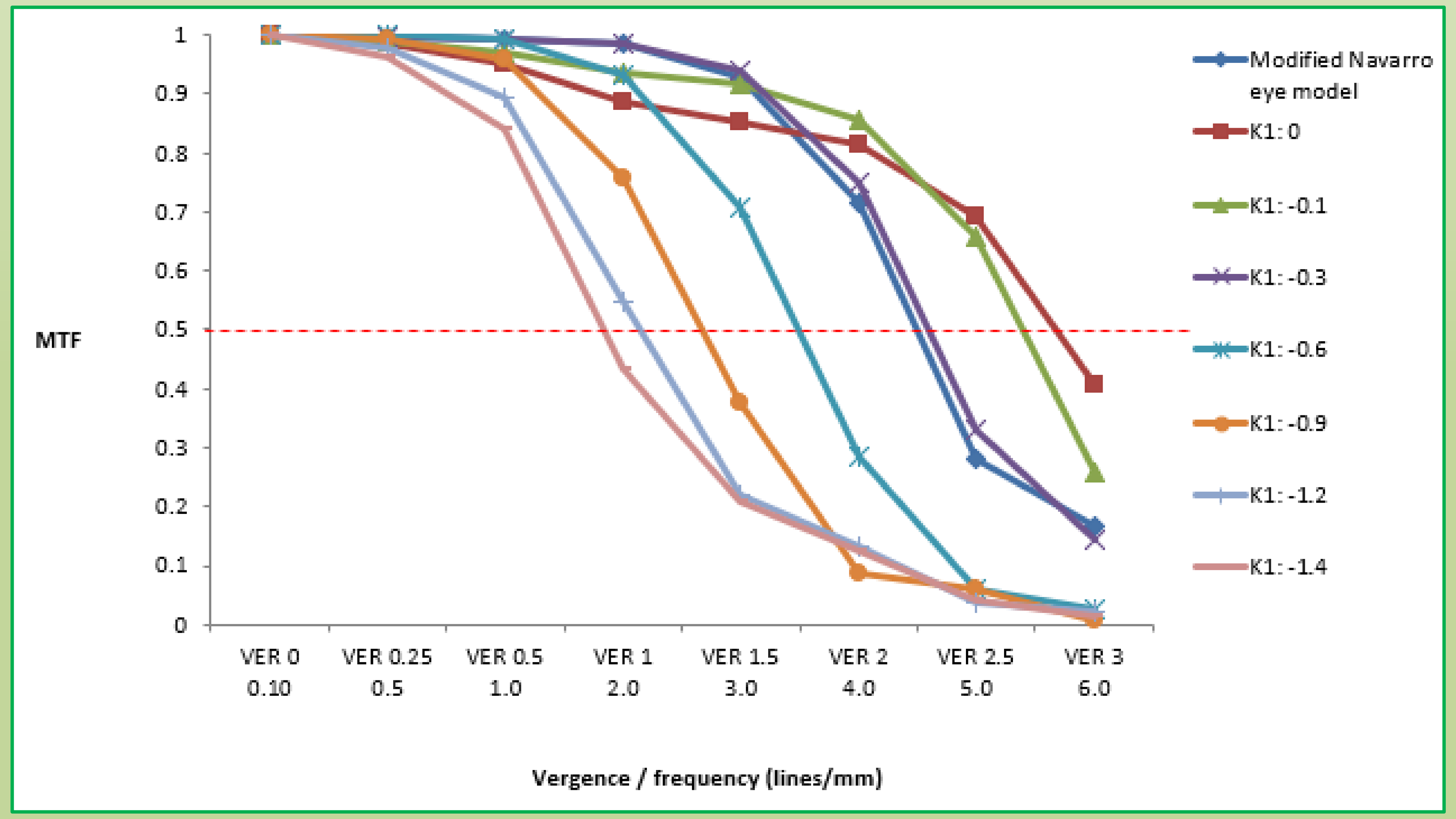

Figure 5.- MTF simulated for different levels of vergence and anterior conic constant in the eye with SA of 0.4 µm

Results:

The main findings of the simulations performed were the following:

- Vergence 3 D: highest MTF for 0 anterior conic constant (Figures 3 to 5)
- Intermediate distance: highest MTF for -0.3 anterior conic constant in eye models with SA 0.0 (Figure 3) and -0.2 µm (Figure 4)
- For the eye model with SA 0.4 µm (Figure 5), overlapping of the behaviour of some designs

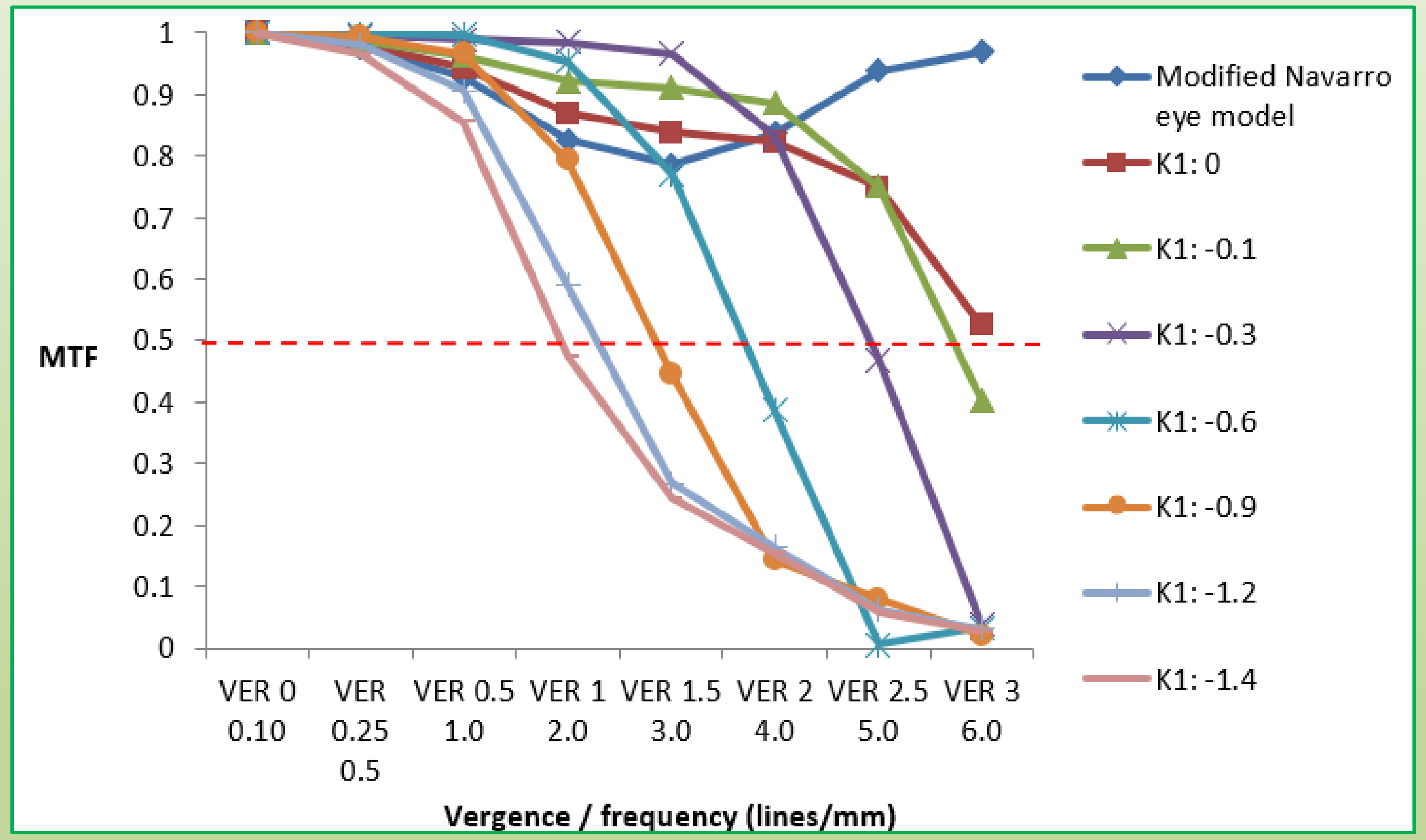

Figure 4.- MTF simulated for different levels of vergence and anterior conic constant in the eye with SA of -0.2 µm

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