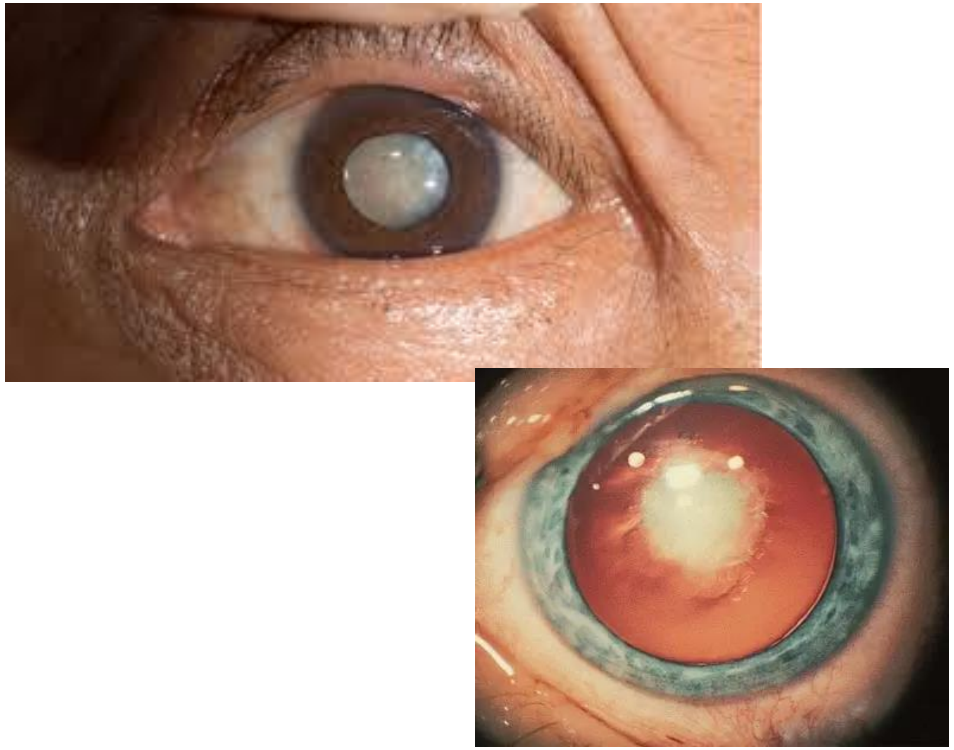
A general overview of multifocal intraocular lenses and their optical properties

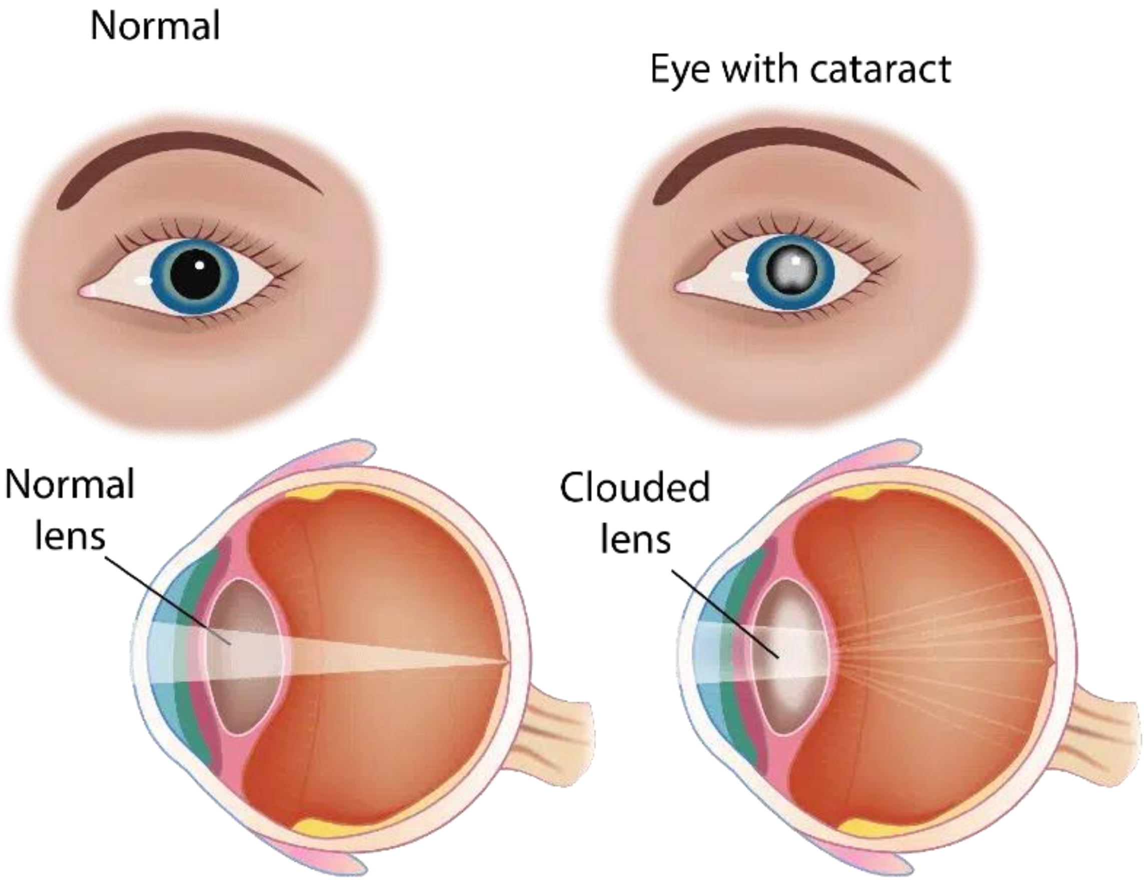
Anabel Martínez-Espert

Departamento de Óptica y Optometría y Ciencias de la Visión, Universitat de València.

Cataracts → Opacification of a crystalline lens

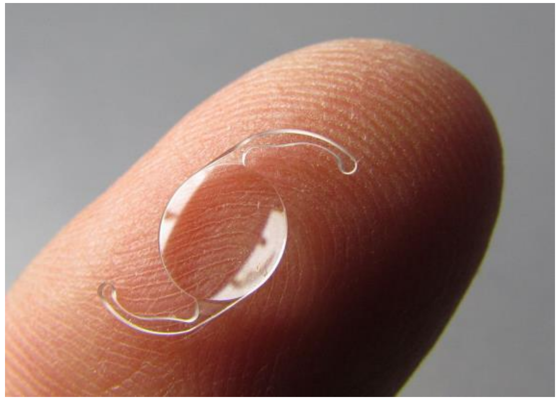


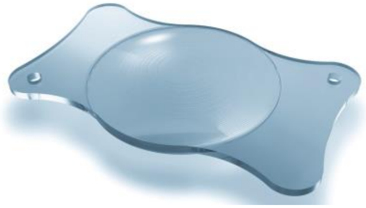
https://www.aao.org/salud-ocular/enfermedades/fotografias-y-videos-de-cataratas



https://www.drchelvinsng.com/zh/what-is-a-cataract-chinese/

Cataracts treatment→ **Intraocular lens**

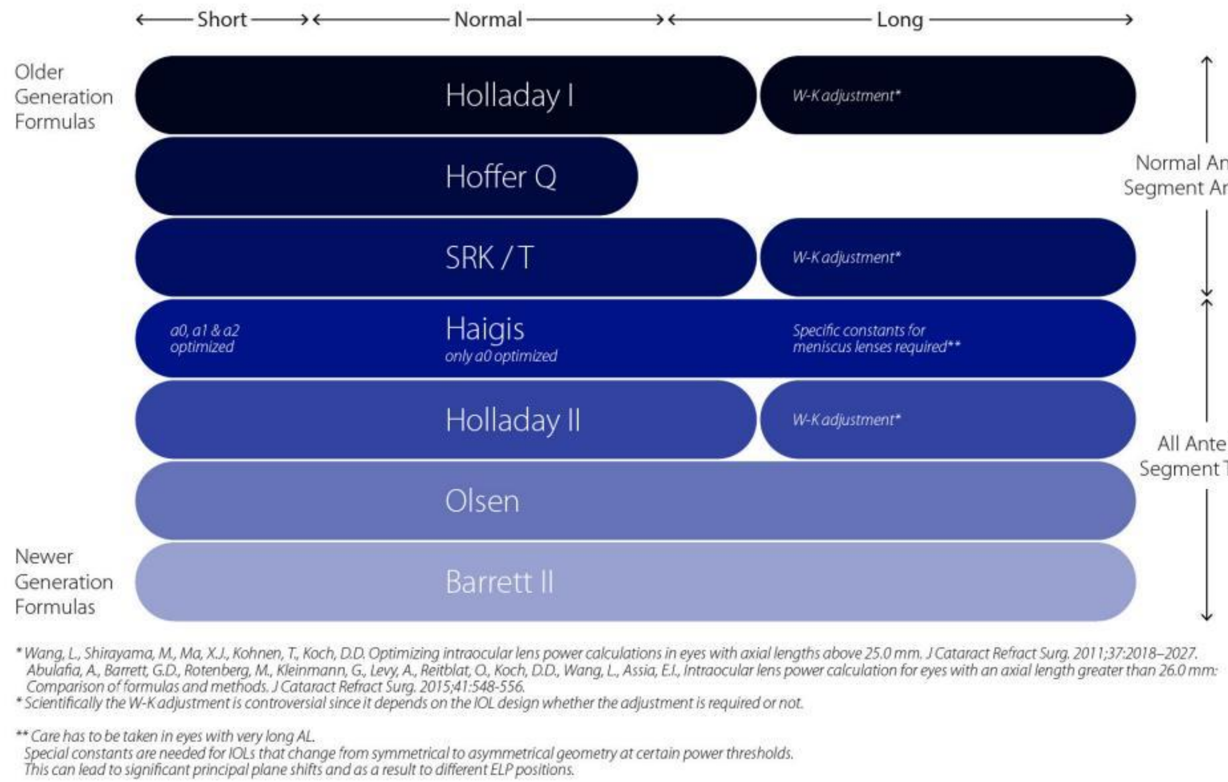




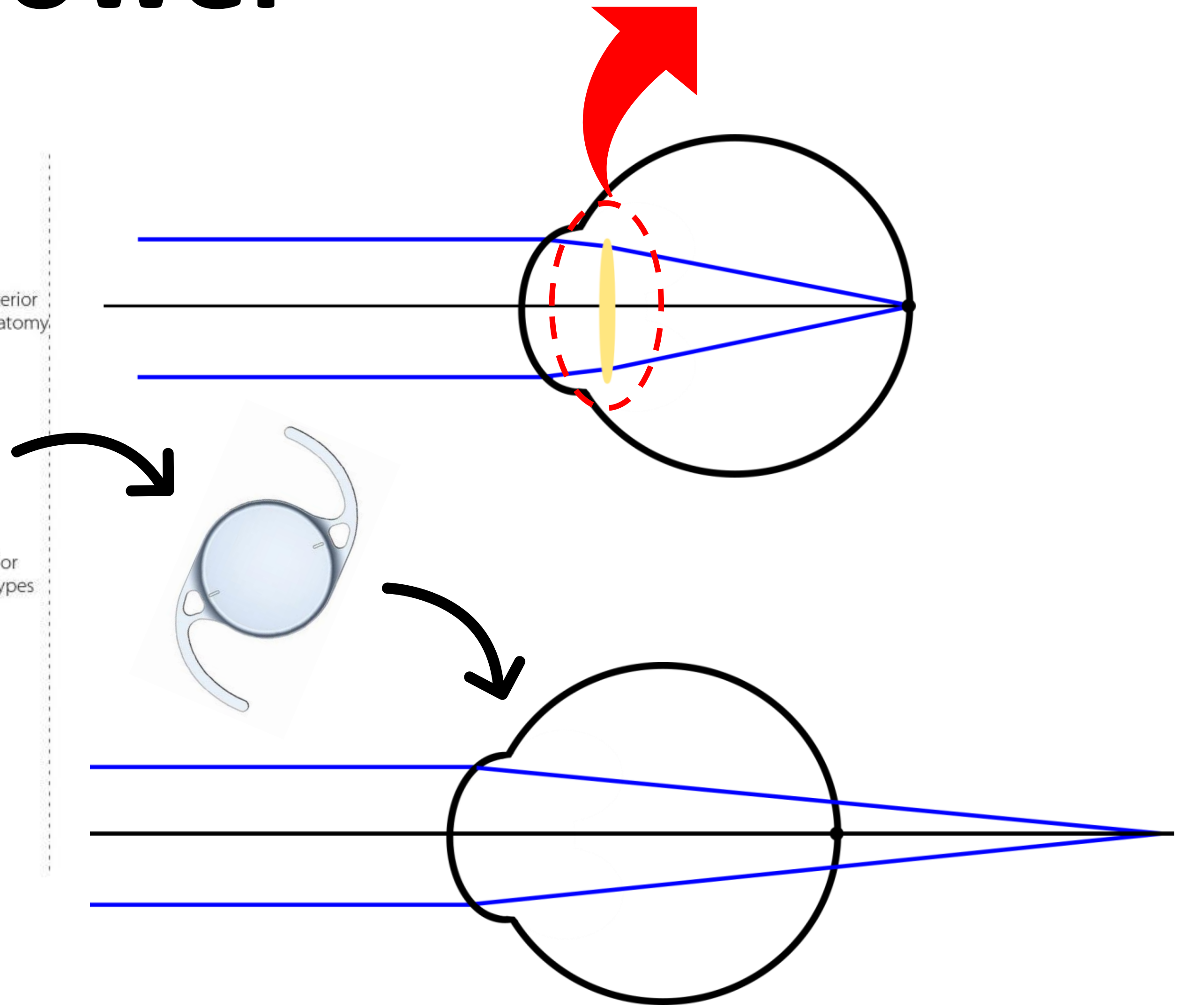
Different types of intraocular lenses

https://www.centroftalmologicointegral.com/cirugia-de-catarata.php

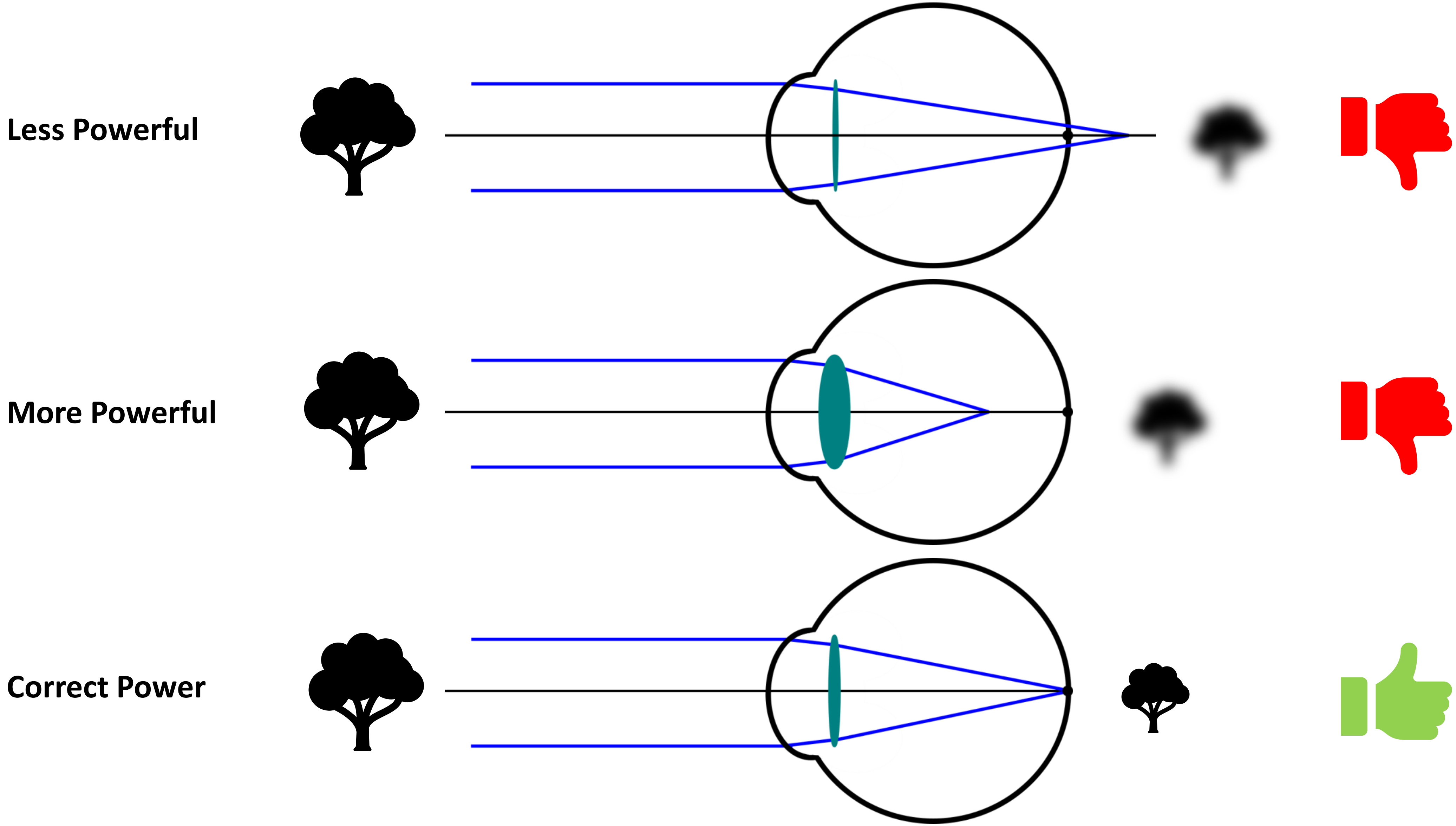
Lens Power



https://www.zeiss.com/meditec/en/c/optical-biometry/iol-power-calculation-formulas-explained.html



Lens Power

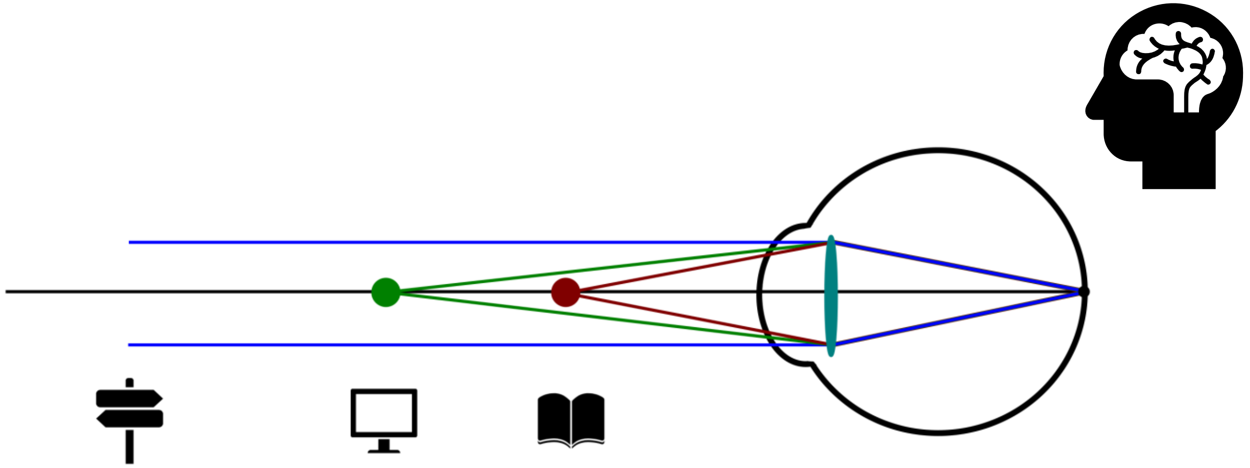


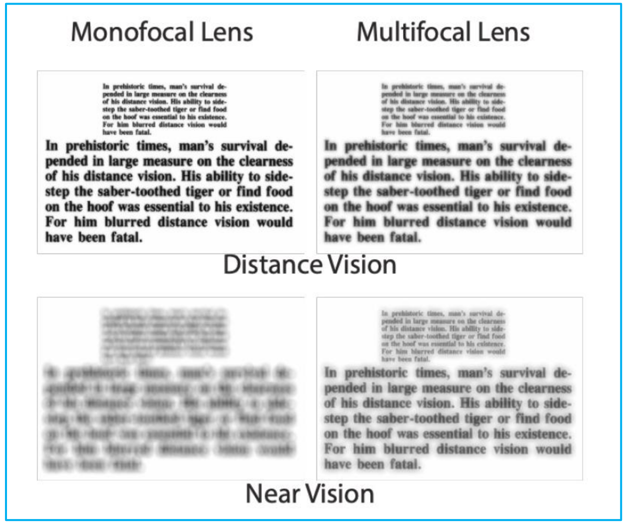
Visual demands → Multifocal intraocular lenses (**MIOLs**)

https://drgabrieloliveros.com/blog/presbicia/

https://www.visionker.com/que-es-la-presbicia-o-vista-cansada/

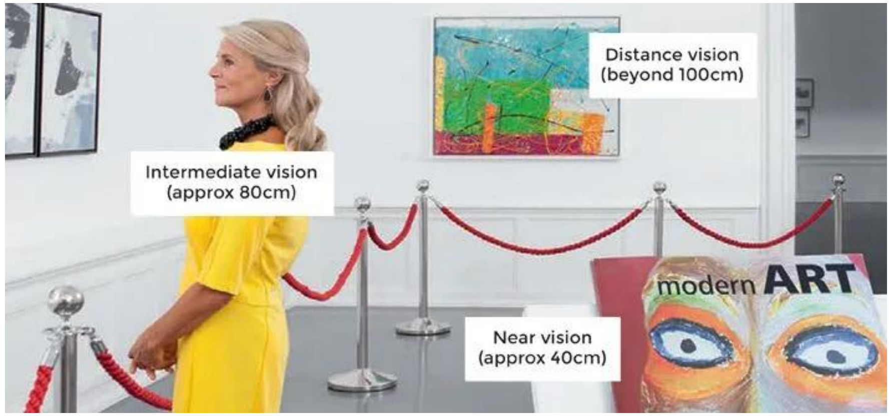
Visual demands → Multifocal intraocular lenses (**MIOLs**)





Monofocal

Multifocal



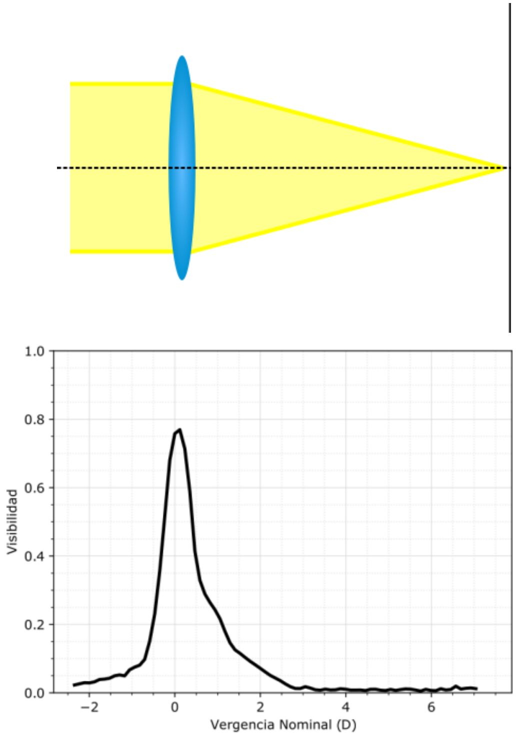
https://www.drjoannegoh.com.au/multifocal-extended-depth-of-focus-edof-lenses/

https://us.alconscience.com/sites/g/files/rbvwei1736/files/pdf/Refractive-and-Diffractive-Principles-in-Presbyopia-Correcting-IOLs-An-Optical-Lesson-US-REF-1900001.pdf

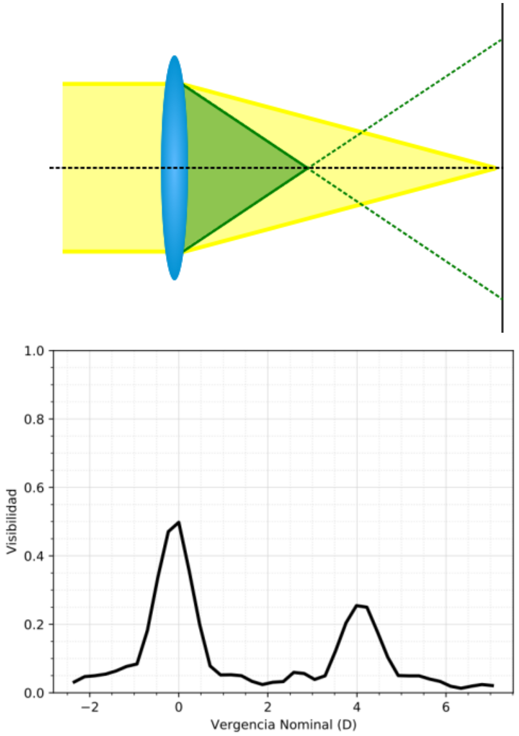
Multifocal intraocular lenses

▷ Designs → Number of foci

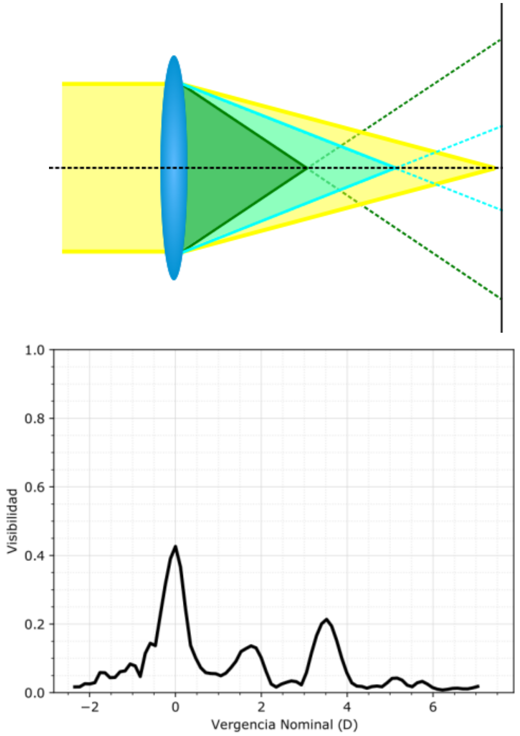
Monofocal



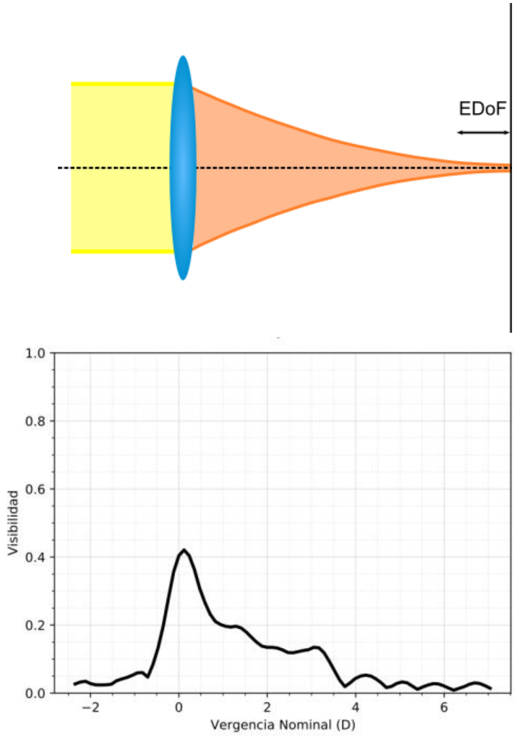
Bifocal



Trifocal



EDoF



Multifocal intraocular lenses

- Design → Technology

Refractive

Diffractive

Salerno, L. C., Tiveron Jr, M. C., & Alió, J. L. (2017). Multifocal intraocular lenses: types, outcomes, complications and how to solve them. *Taiwan journal of ophthalmology*, *7*(4), 179.

Refractive MIOLs

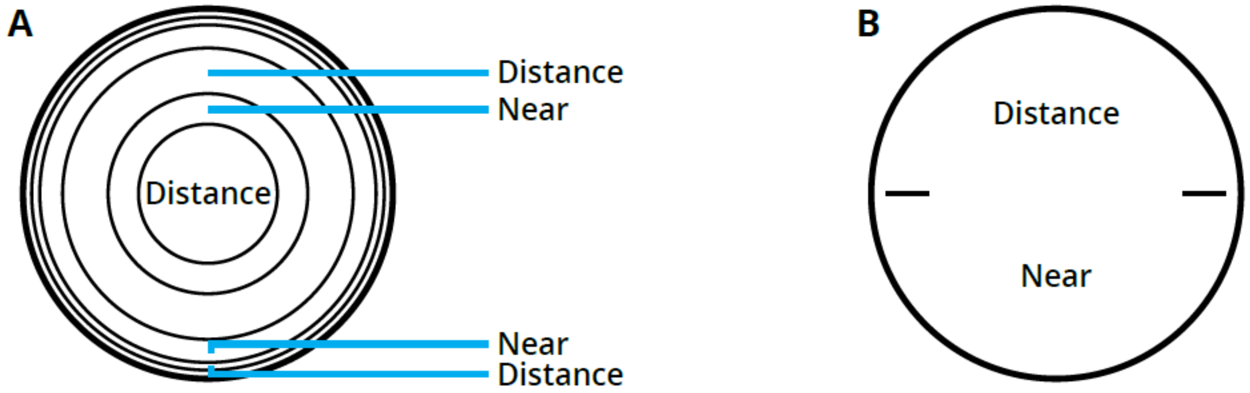
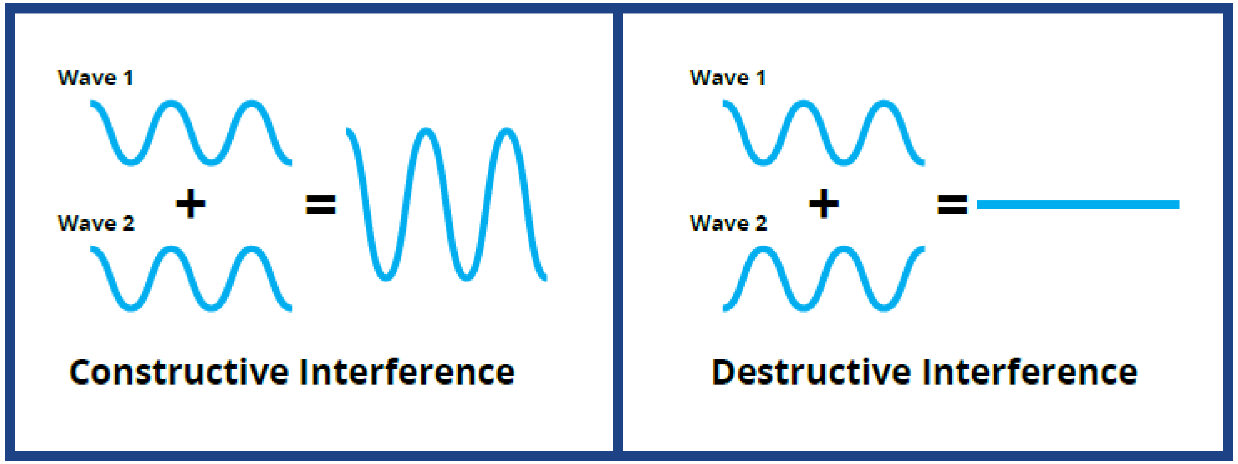


Figure 2. Examples of refractive multifocal optic design. (A) Alternating zones of varying refractive power (zonal refractive lens). (B) Radial sectors that provide near and distance (sector refractive lens.

https://us.alconscience.com/sites/g/files/rbvwei1736/files/pdf/Refractive-and-Diffractive-Principles-in-Presbyopia-Correcting-IOLs-An-Optical-Lesson-US-REF-1900001.pdf

Diffractive MIOLs



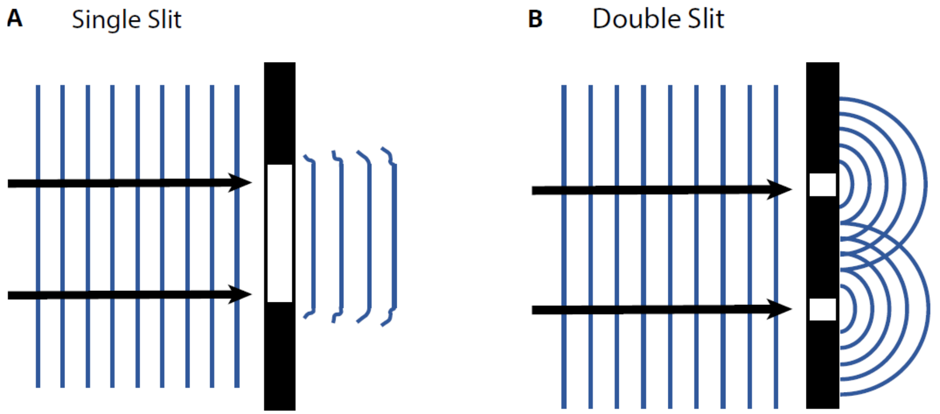
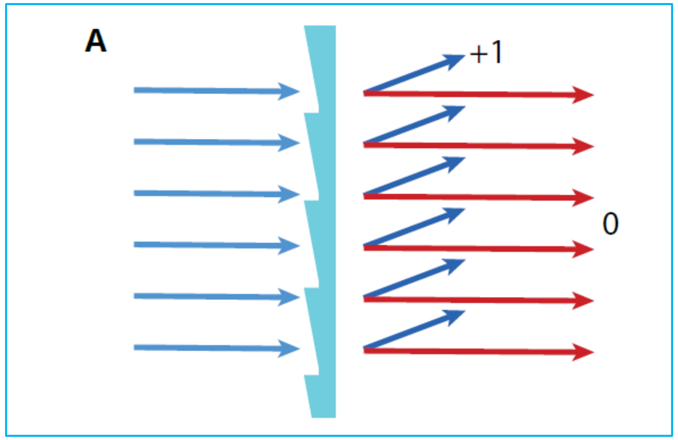
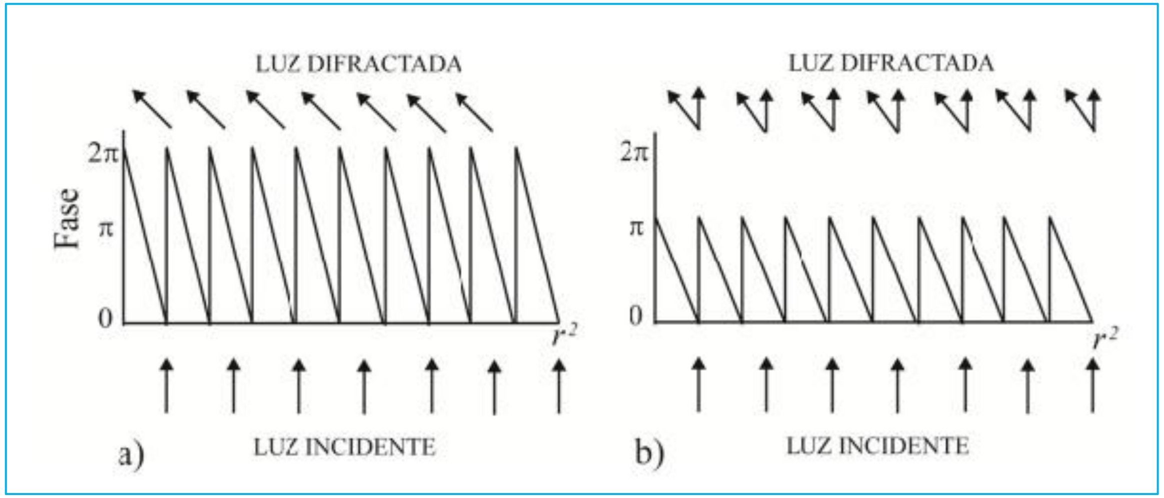


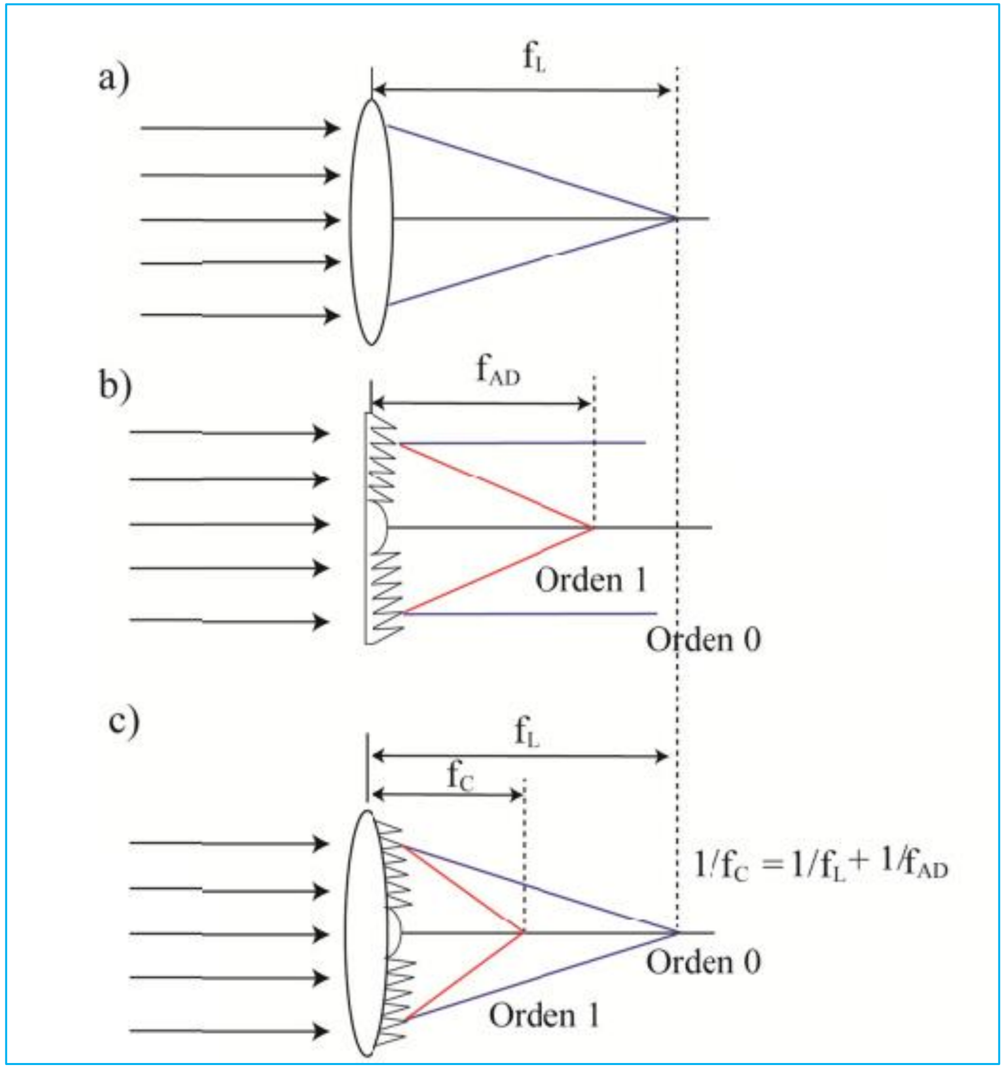
Figure 6. Diffraction. A) Light passing through a single wide slit propagates unaffected through the region of the opening. B) Light passing through two small slits bents and waves emanating from the slits can overlap and undergo constructive and destructive interference.

https://us.alconscience.com/sites/g/files/rbvwei1736/files/pdf/Refractive-and-Diffractive-Principles-in-Presbyopia-Correcting-IOLs-An-Optical-Lesson-US-REF-1900001.pdf

Diffractive MIOLs

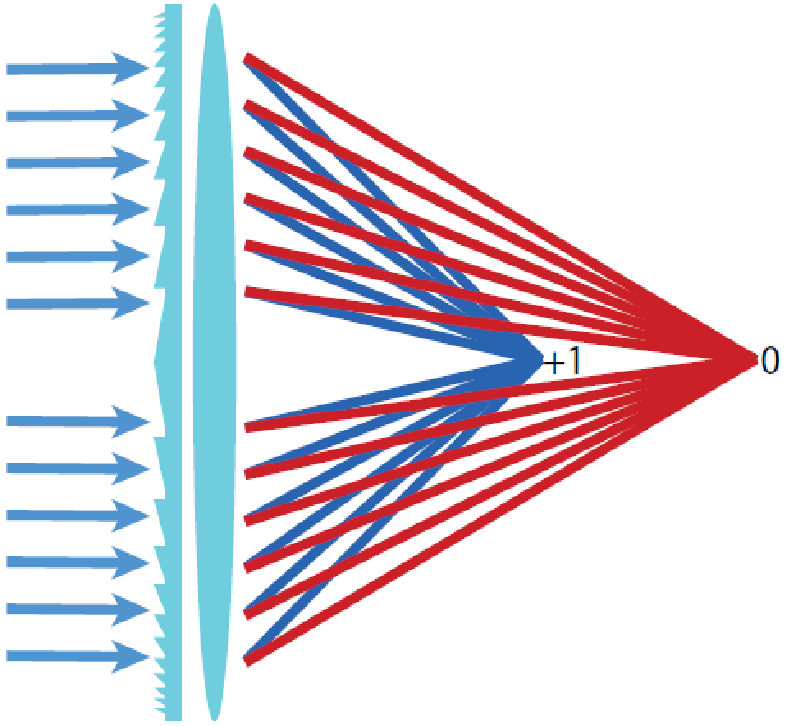


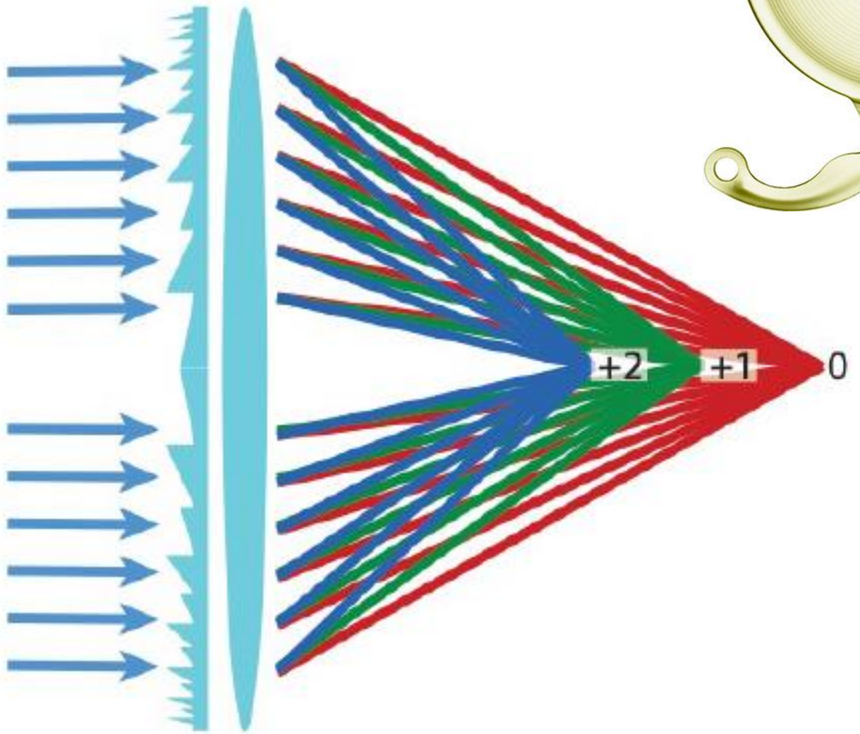




Remón L. Diseño, fabricación y control de calidad de lentes intraoculares multifocales.
https://us.alconscience.com/sites/g/files/rbvwei1736/files/pdf/Refractive-and-Diffractive-Principles-in-Presbyopia-Correcting-IOLs-An-Optical-Lesson-US-REF-1900001.pdf

Diffractive MIOLs

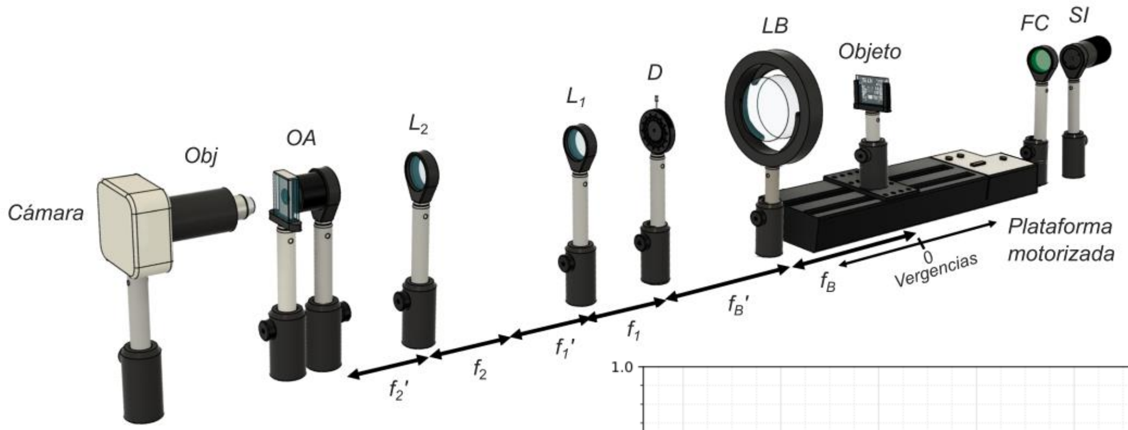


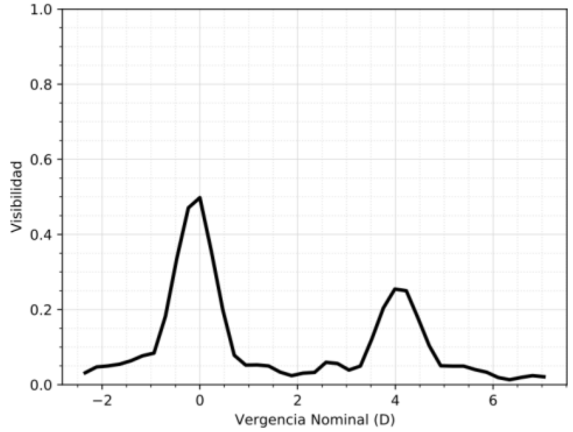


https://us.alconscience.com/sites/g/files/rbvwei1736/files/pdf/Refractive-and-Diffractive-Principles-in-Presbyopia-Correcting-IOLs-An-Optical-Lesson-US-REF-1900001.pdf

Optical and visual quality

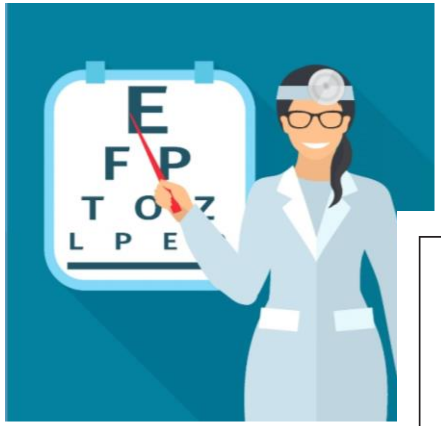
Optical quality





In vitro

Visual quality



In vivo

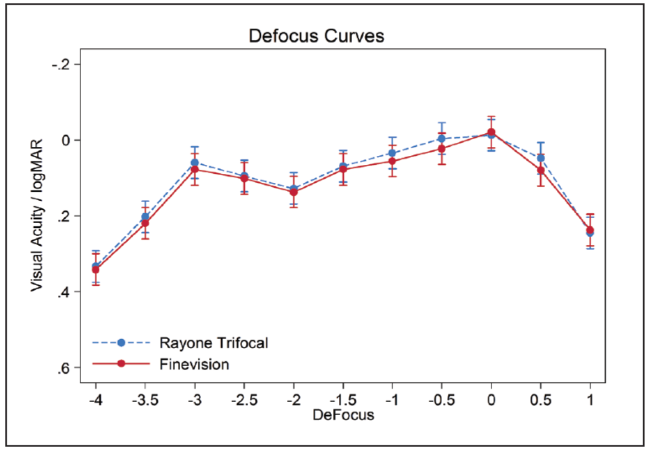
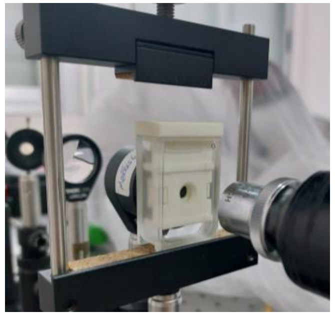
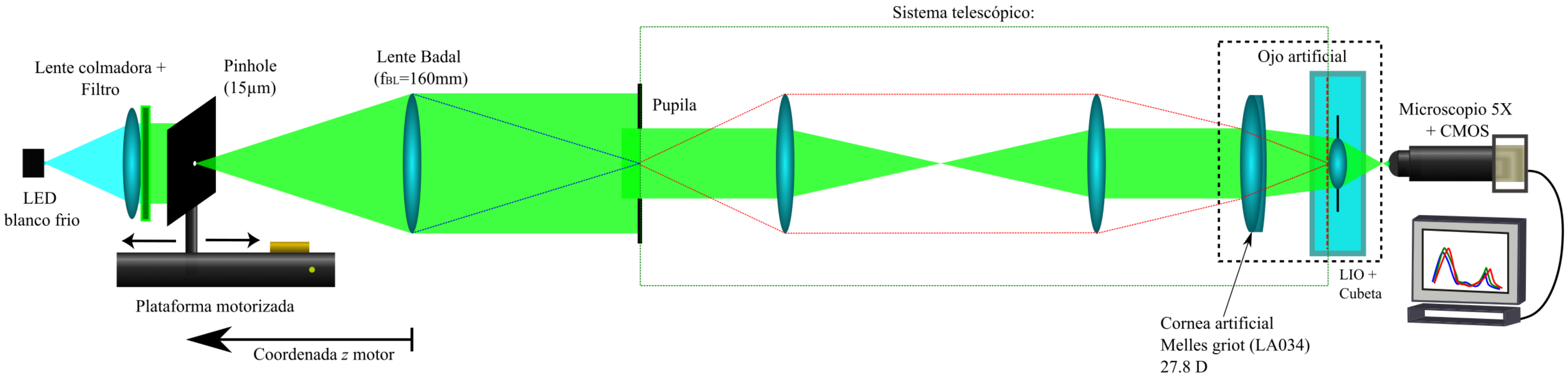


Figure 3. Binocular defocus curves under photopic conditions. The RayOne Trifocal intraocular lens is manufactured by Rayner, Worthing, UK, and the FineVision POD F intraocular lens is manufactured by PhysIOL, Liège, Belgium.

Ferreira, T. B., & Ribeiro, F. J. (2019). *Journal of Refractive Surgery*, *35*(7), 418-425.

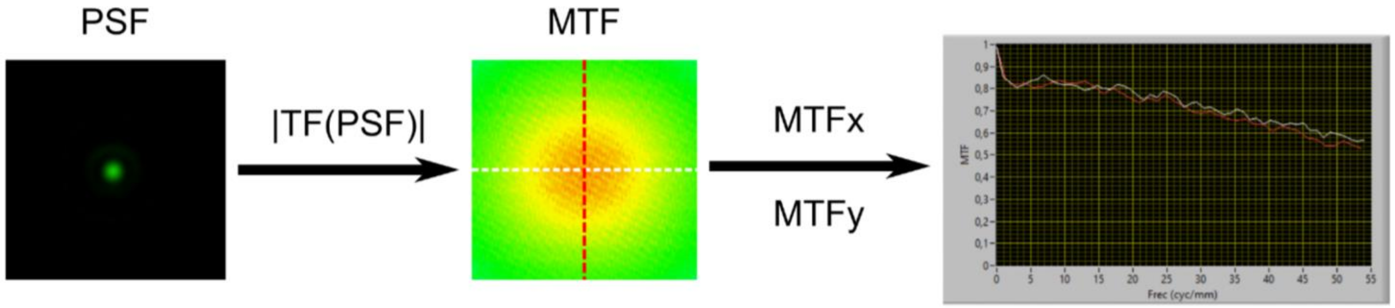
In vitro

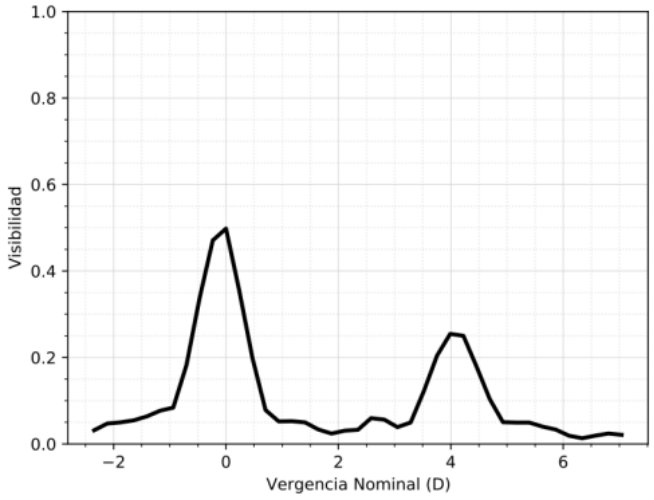


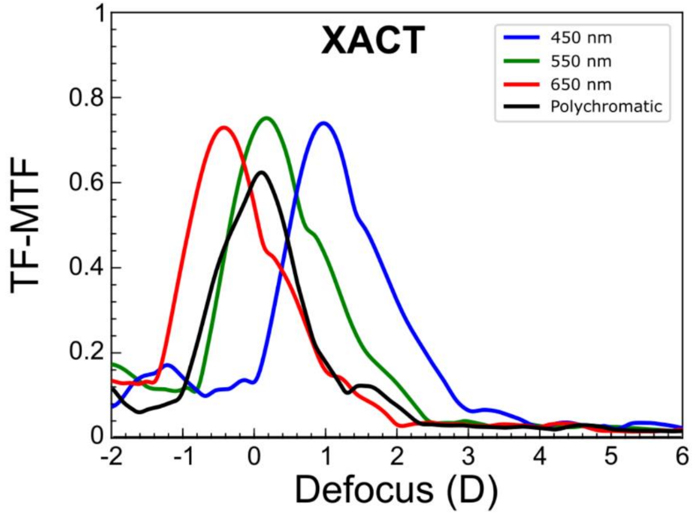

Sistema telescópico:
Lente colmadora +
Filtro
Pinhole
(15µm)
Lente Badal
(fBL=160mm)
Pupila
Ojo artificial
Microscopio 5X
+ CMOS
LED
blanco frio
Plataforma motorizada
Coordenada z motor
LIO +
Cubeta
Cornea artificial
Melles griot (LA034)
27.8 D

In vitro

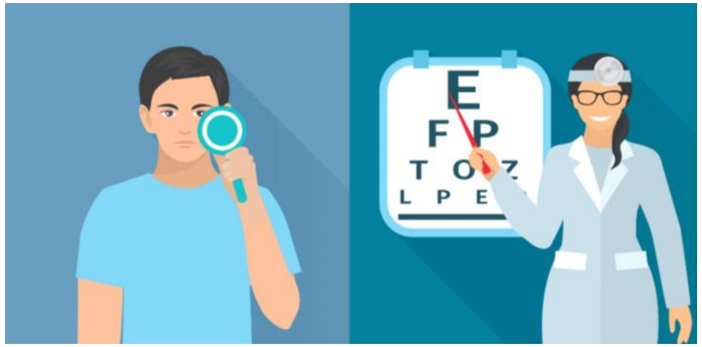
$$MTF\left(f_x, f_y\right) = \text{Modulo}\left[FT\left\{PSF(x_i, y_i)\right\}\right]$$

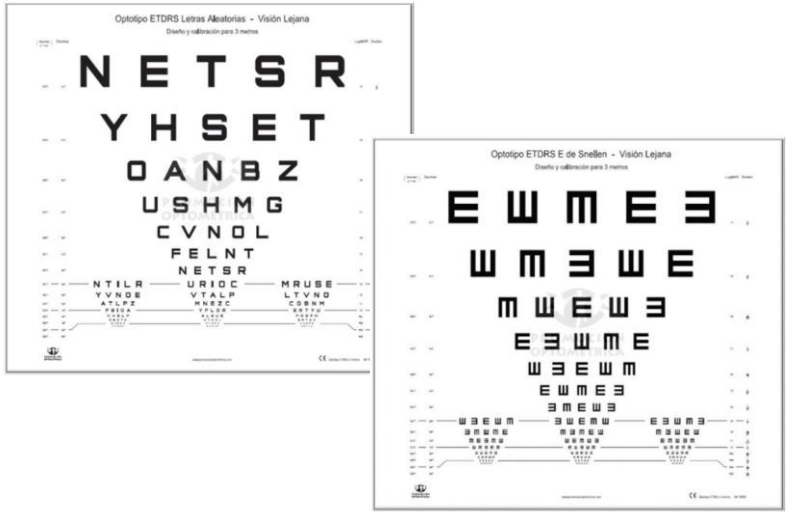






In vivo





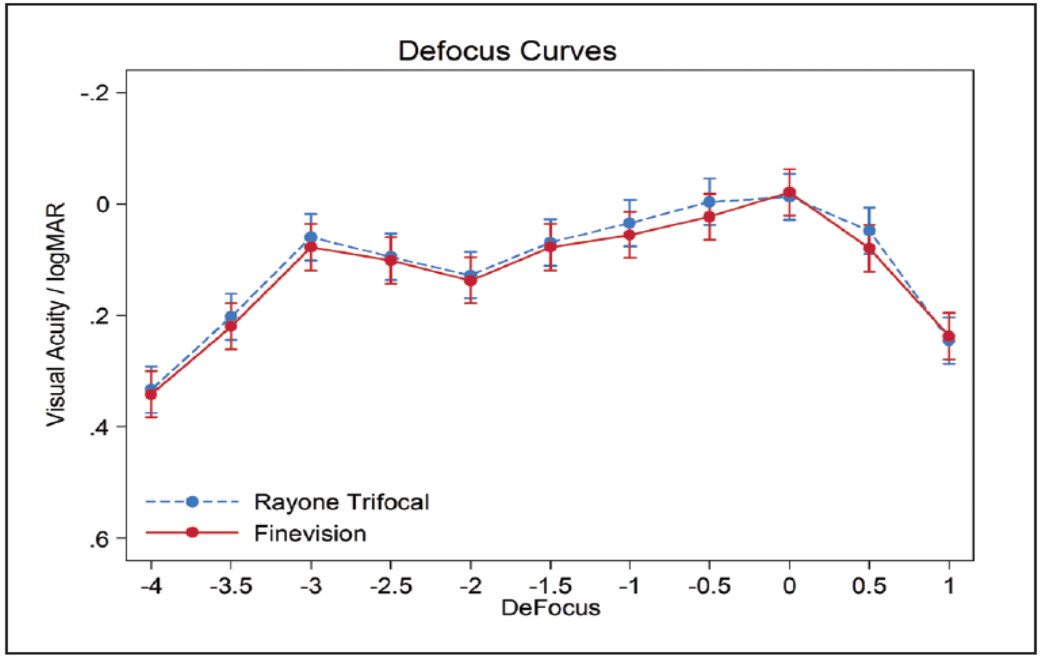


Figure 3. Binocular defocus curves under photopic conditions. The RayOne Trifocal intraocular lens is manufactured by Rayner, Worthing, UK, and the FineVision POD F intraocular lens is manufactured by PhysIOL, Liège, Belgium.

Ferreira, T. B., & Ribeiro, F. J. (2019). Prospective comparison of clinical performance and subjective outcomes between two diffractive trifocal intraocular lenses in bilateral cataract surgery. *Journal of Refractive Surgery*, *35*(7), 418-425.

17

Conclusions

A general overview of multifocal intraocular lenses and their optical properties

Anabel Martínez-Espert

Departamento de Óptica y Optometría y Ciencias de la Visión, Universitat de València.