

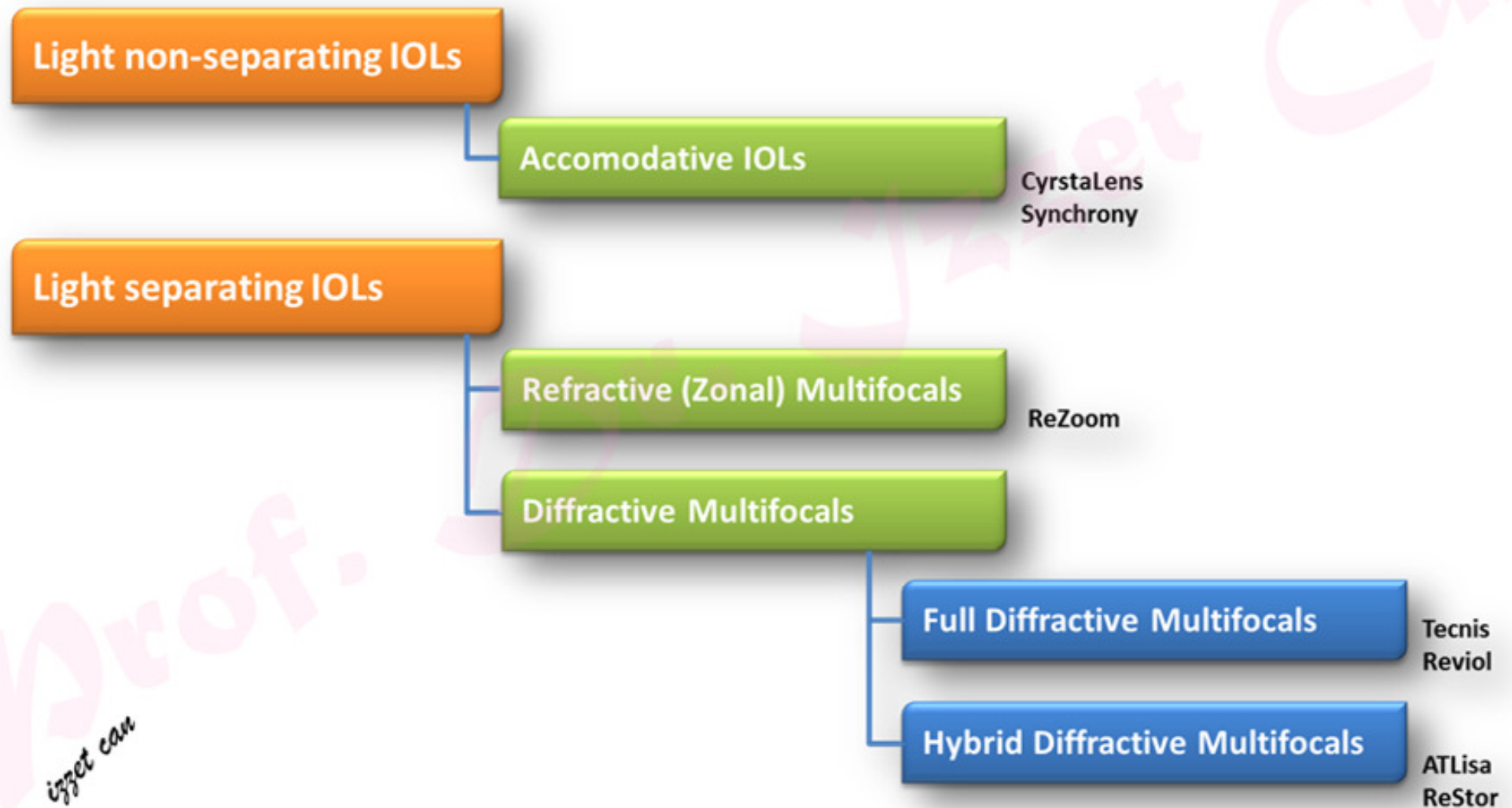
Reviol Tri-ED

Firstly

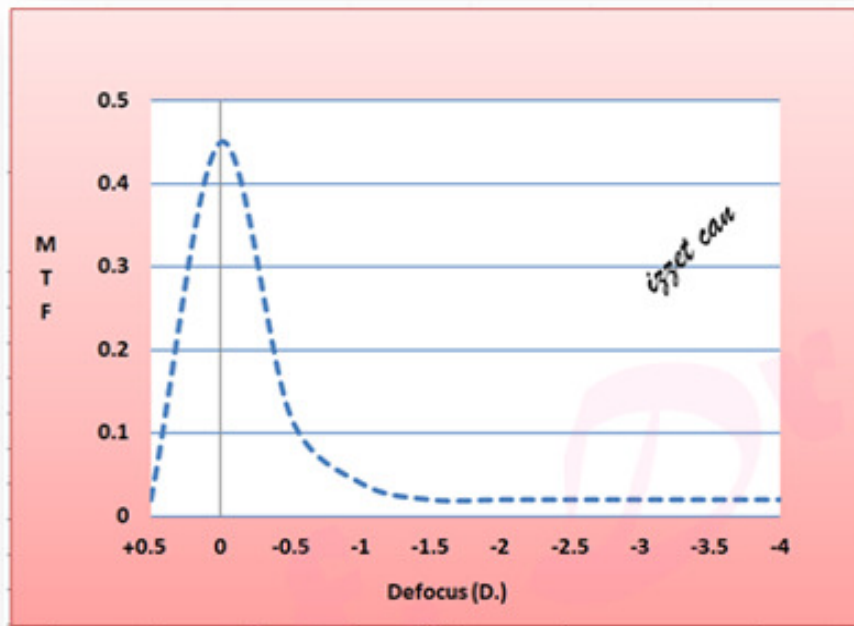
Both Trifocality and Enhanced Depth of Focus

İzzet Can, MD, Prof.
Mayagöz, Ankara Turkey

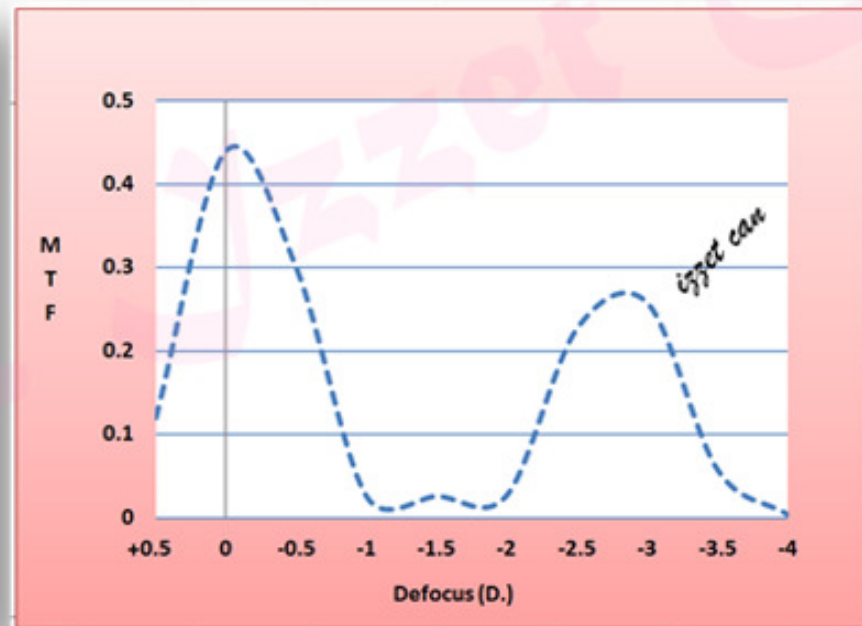
where are we in presbyopic cataract surgery today?



are multifocals really multifocal?



MONOFOCAL
IOL



~~MULTIFOCAL
IOL~~

BIFOVAL
IOL

what is diffraction?

Refraction

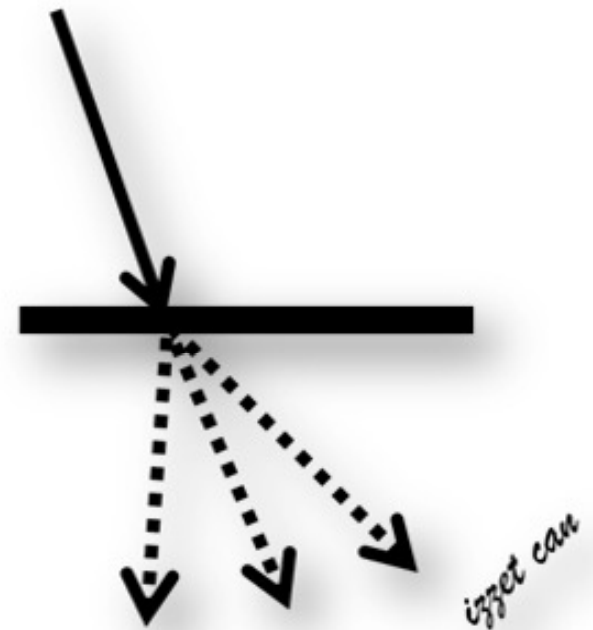
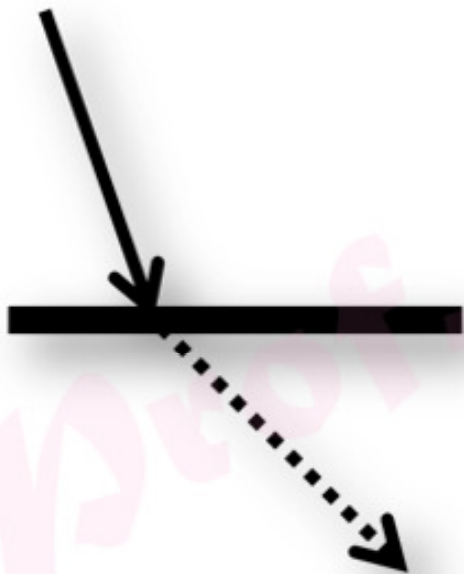
Light passes to the other side but bends with an angle.

Reflection

Light returns with an angle.

Scatter

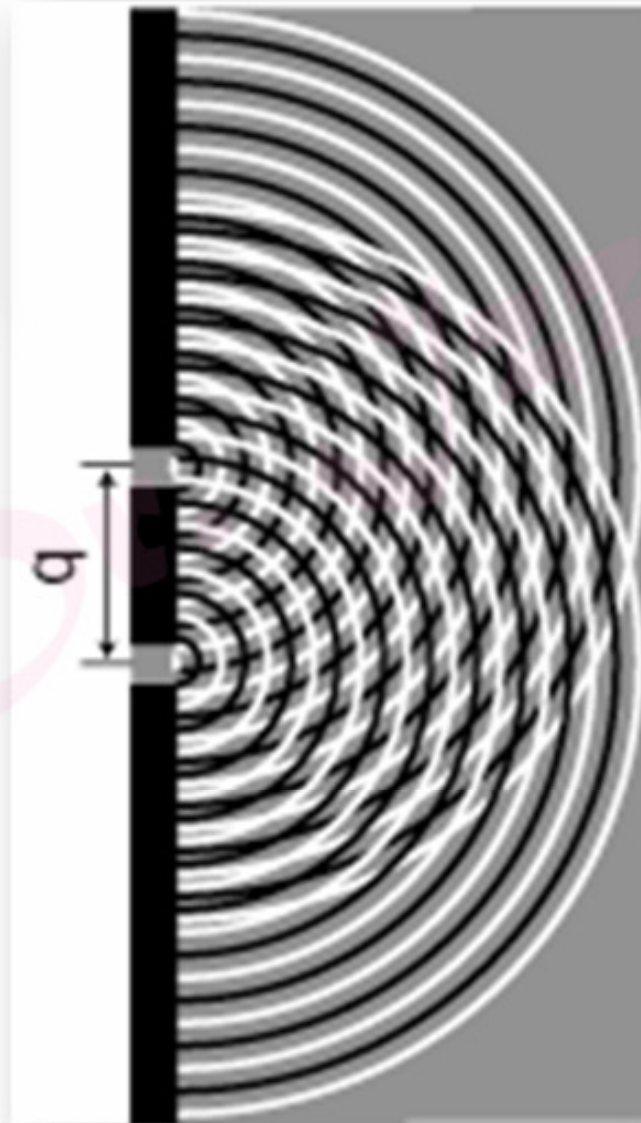
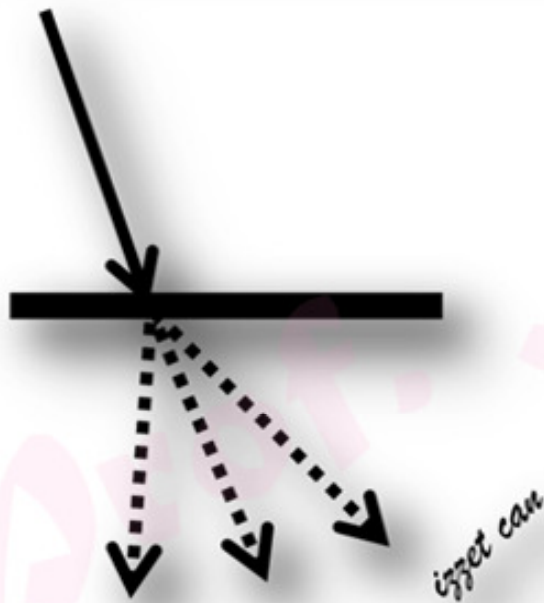
Light passes to the other side but regularly or irregularly separates.



what is diffraction?

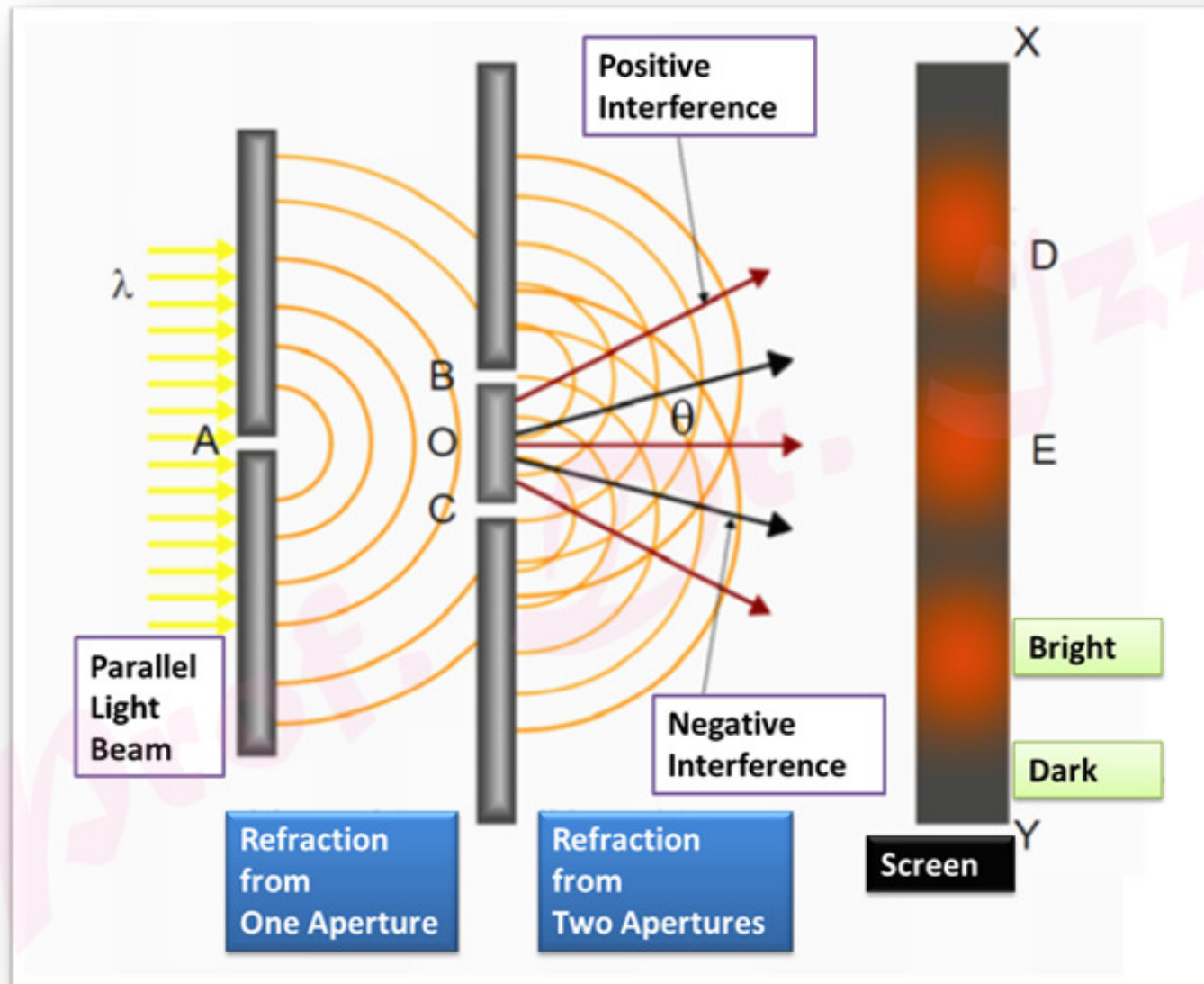
Scatter

Light passes to the other side but regularly or irregularly separates.

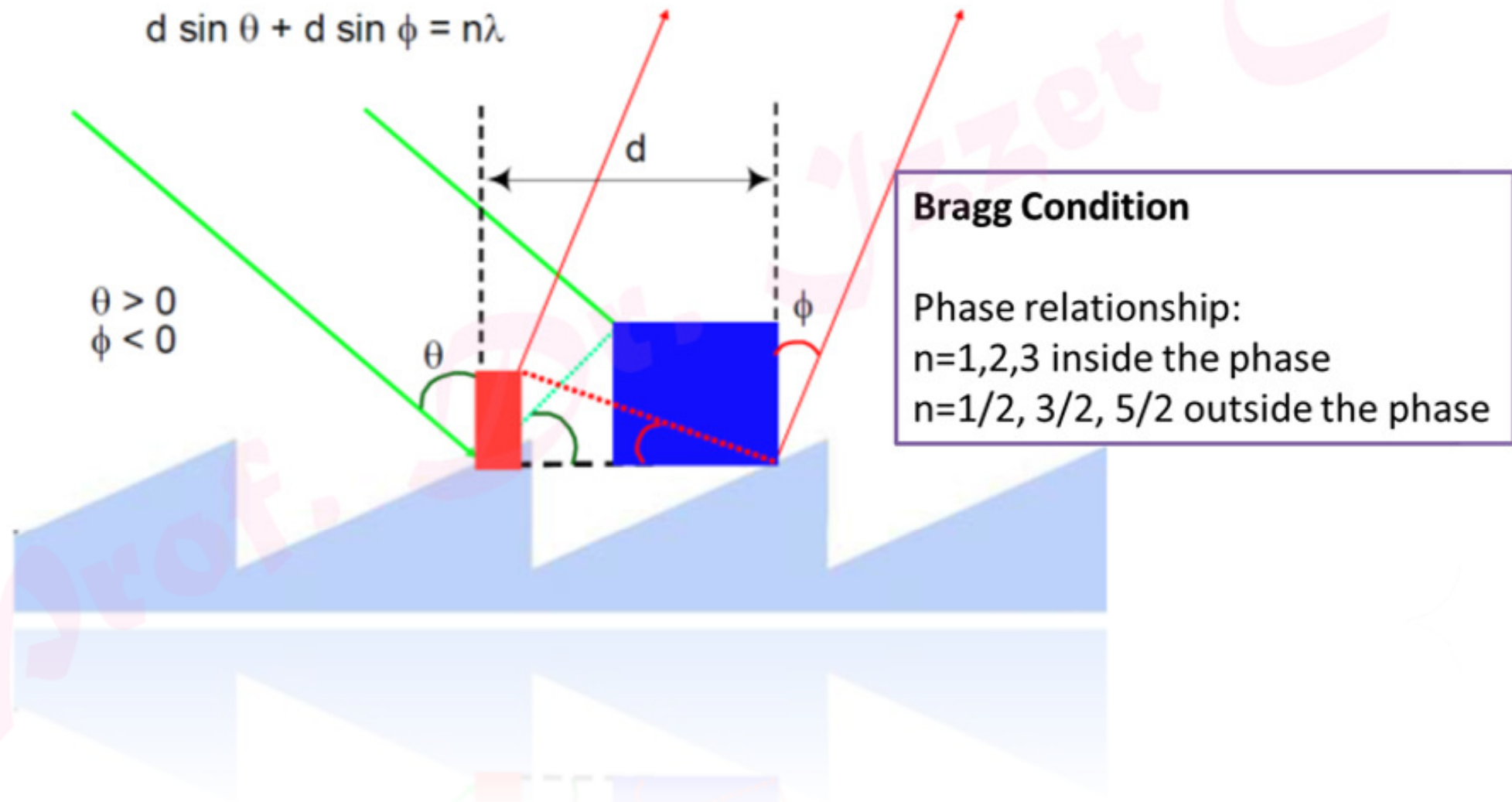


Diffraction is the slight bending of light as it passes around the edge of an object or through the aperture. The amount of bending depends on the relative size of the wavelength of light to the size of the opening. The **diffraction** phenomenon is described as the interference of waves according to the Huygens–Fresnel principle.

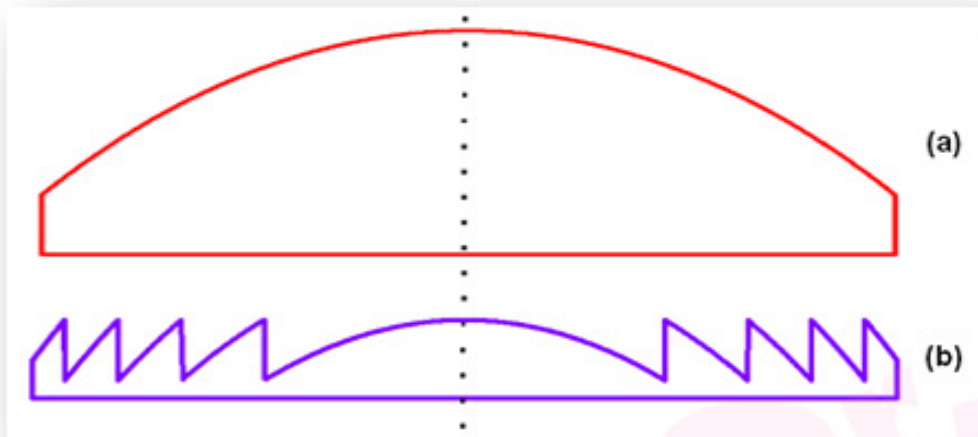
what is diffraction?



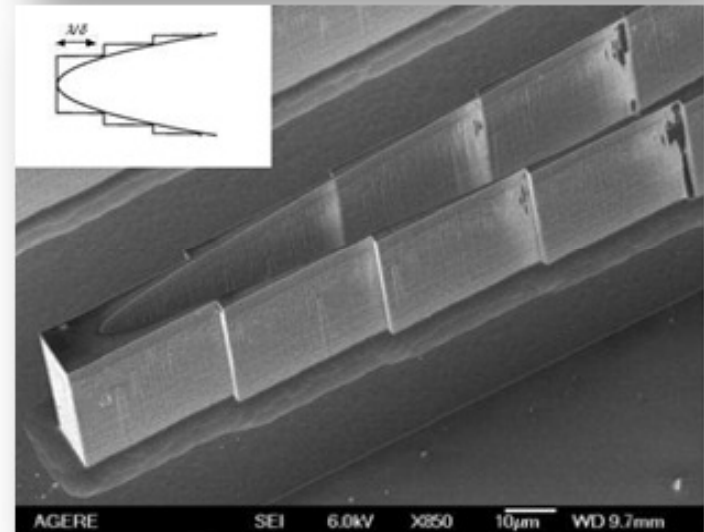
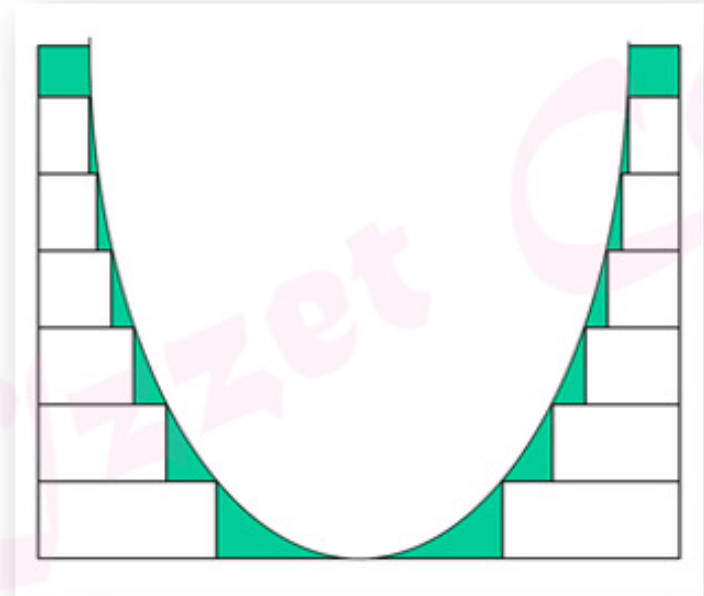
how to create diffraction?



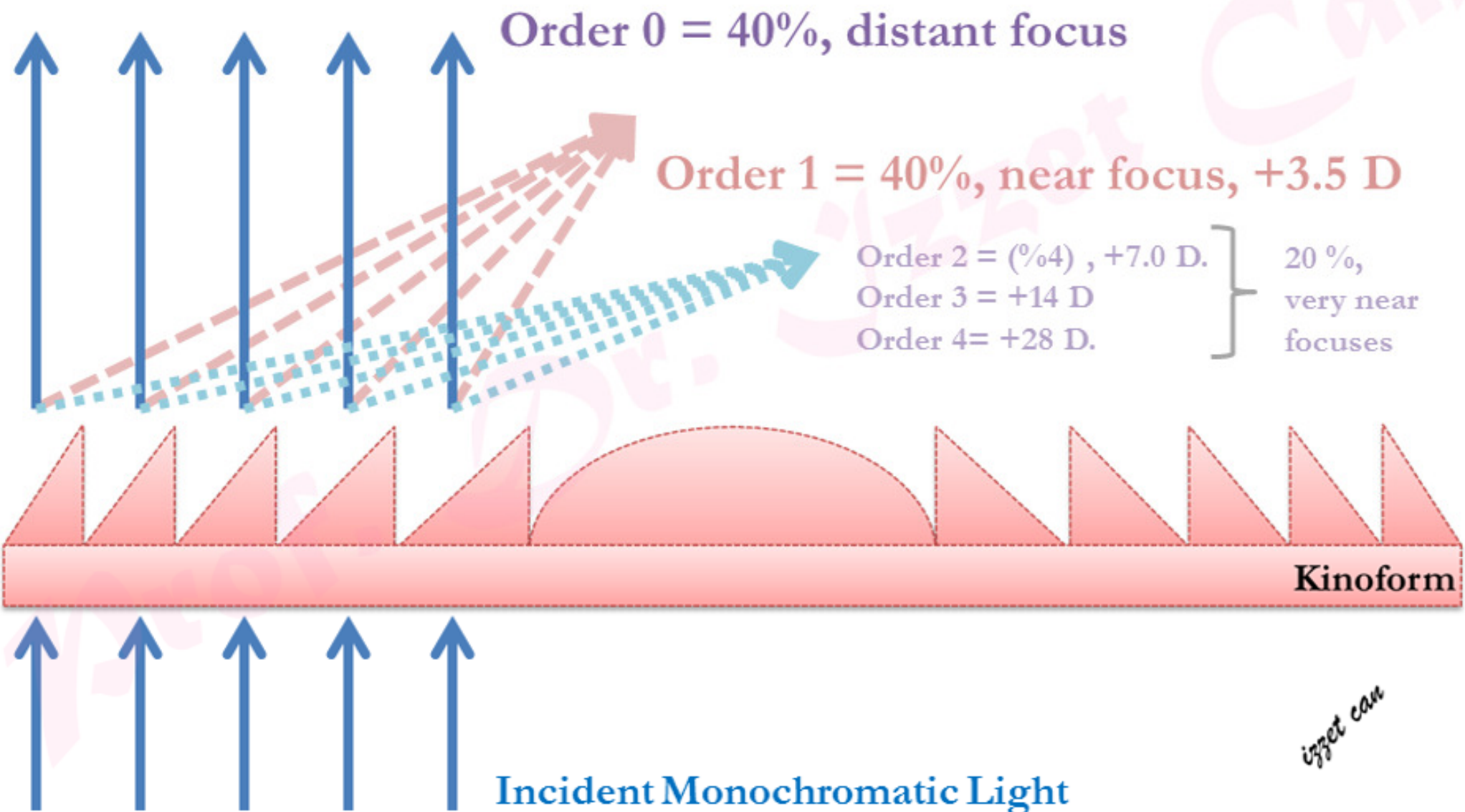
what is kinoform?



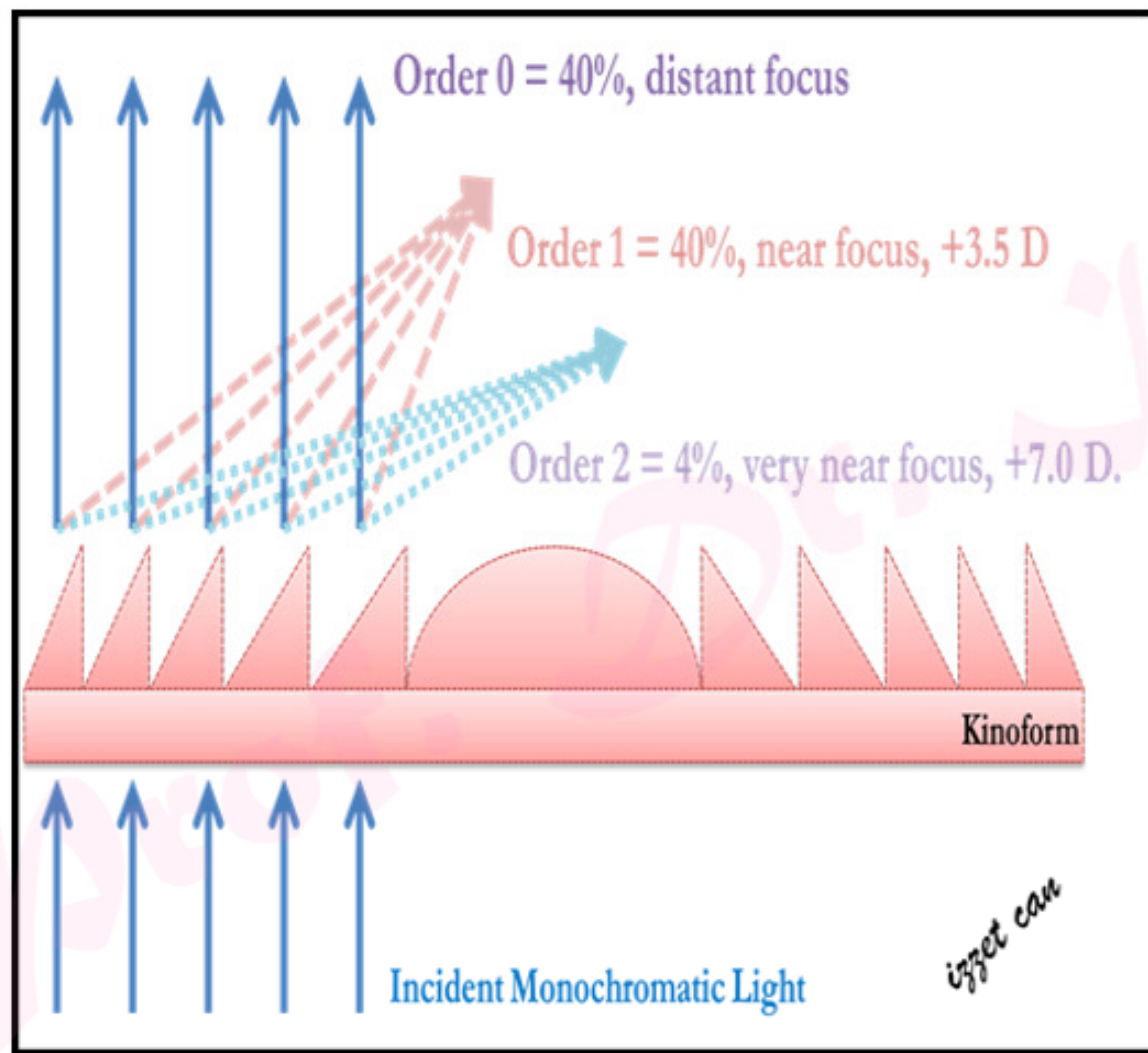
In gross approximation, the profile of the kinoform resembles that of an asymmetric **“saw-tooth”** profile



bifocal (or multifocal) lens design



bifocal (or multifocal) lens design



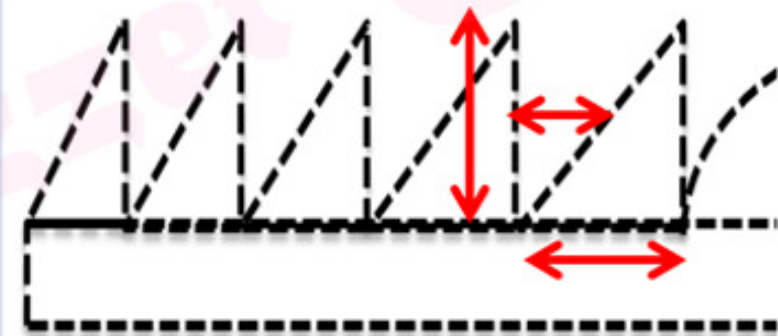
One interesting properties of kinoforms:

There is a **directly proportional relationship** between the diffraction orders and their respective vergences.

ORDER	VERGENCE (D.)
0	0
1	+ 3.5
2	+ 7.0
3	+ 14.0

kinoforn lens, steps and variables

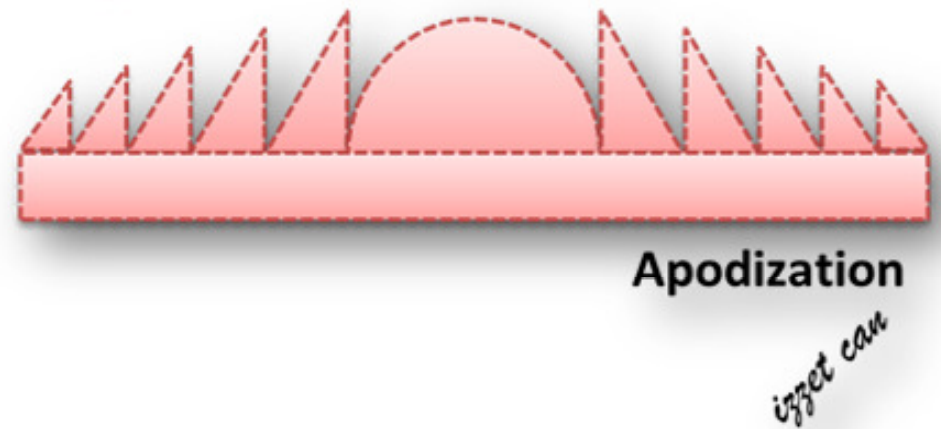
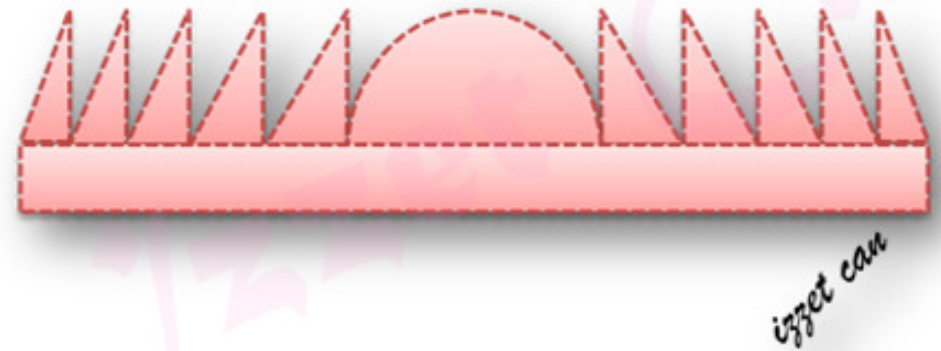
variables	determination	explanation
width	vergence	Width of the steps governs the distance to where the 1st (and subsequent) orders will come into focus.
height	repartition	Height of the steps governs the repartition of the incident light energy between the various diffraction orders
spacing	depth of focus	Spaces between steps governs the focus depth



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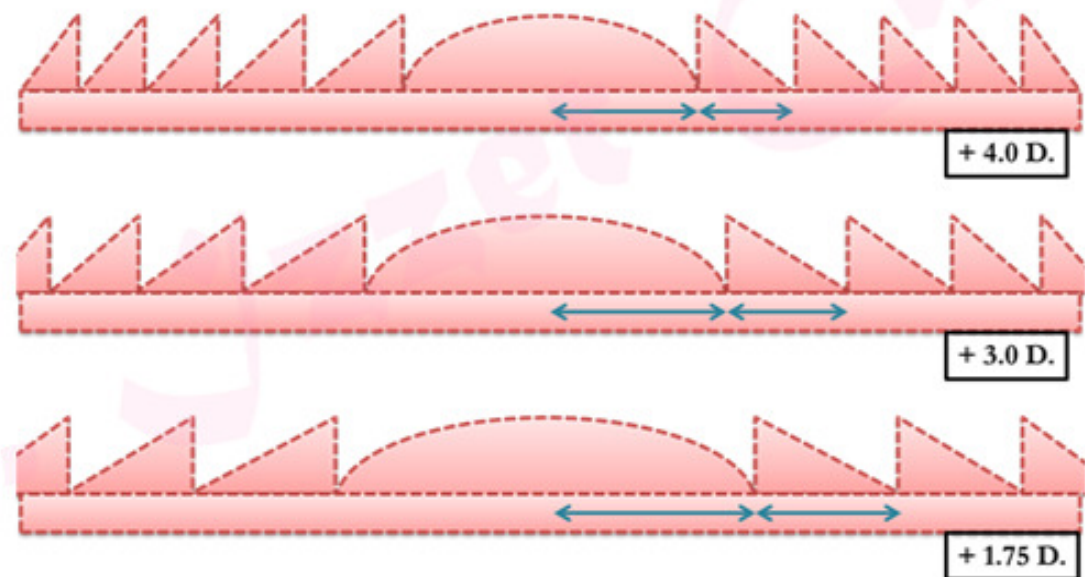
height

- This parameter determines the repartition of incoming light to the diffractive orders.
- If you make the heights equal this will end up with constant split proportions between 0 and 1st orders (far and near focuses).
- If you reduce the height of the steps progressively to the periphery, this is called «apodization». Now peripheral steps will have more partion for far vision in case of dilated pupil.



width

- This parameter determines the distance of the focuses.
- Steps widths always decrease from center to the periphery.
- If you make the width of the steps equal, direction of the 1st orders light will parallel to the 0 order and will not converge to make near focus.
- And higher the widths lower the space between steps, this will controls the amount of added vergence.

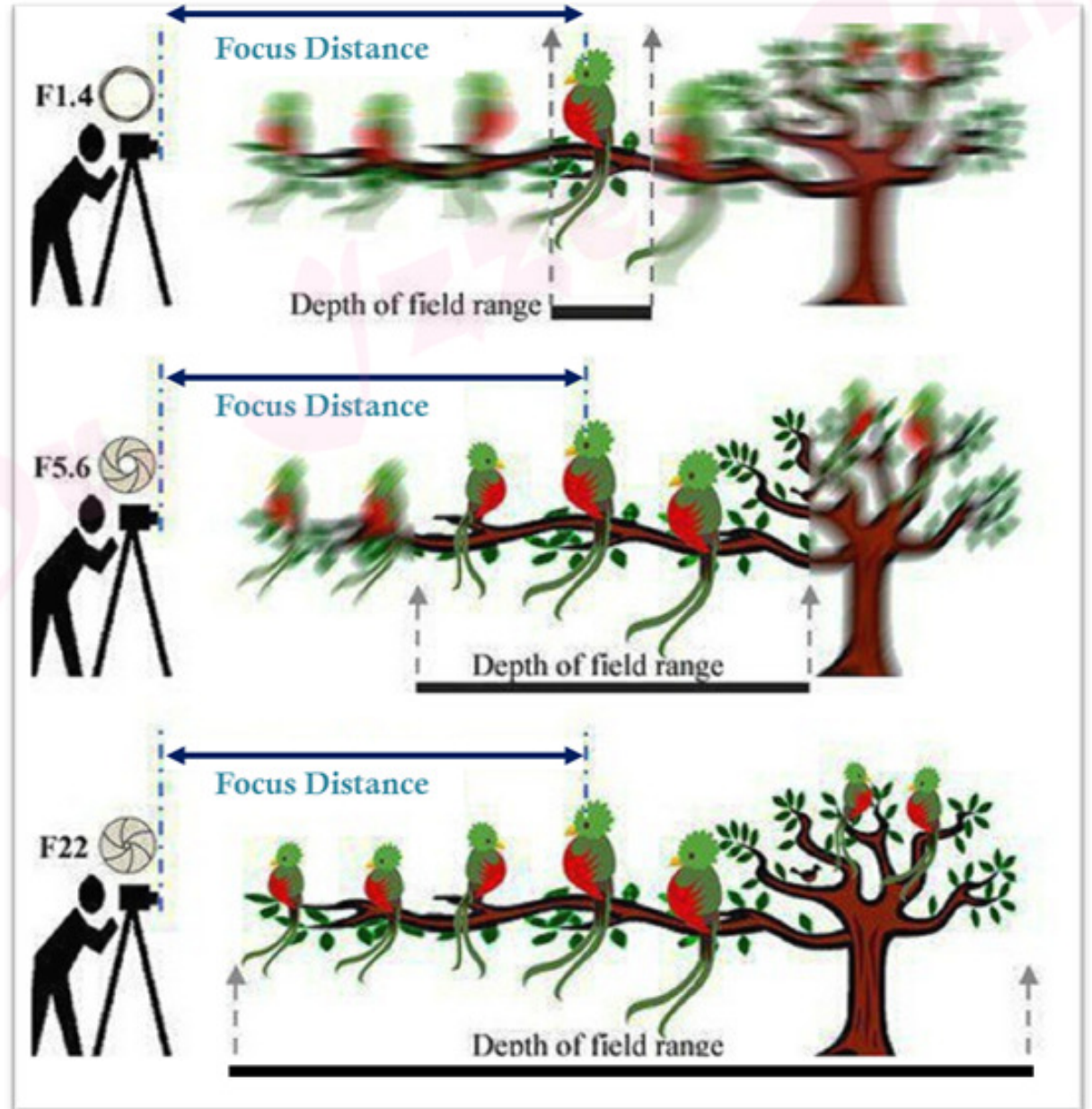
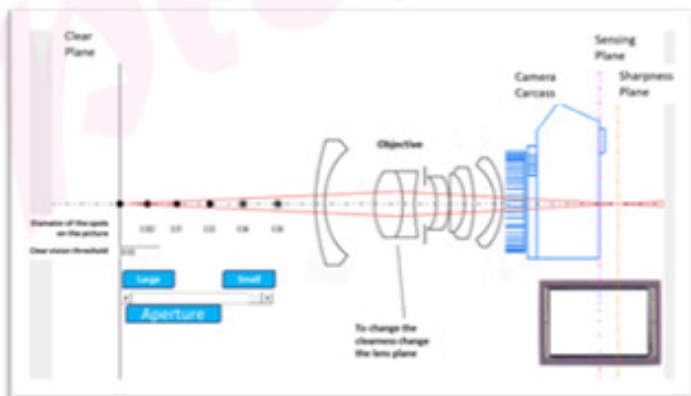
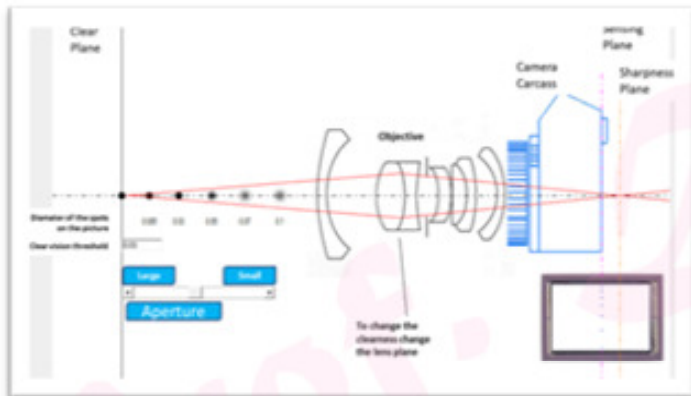
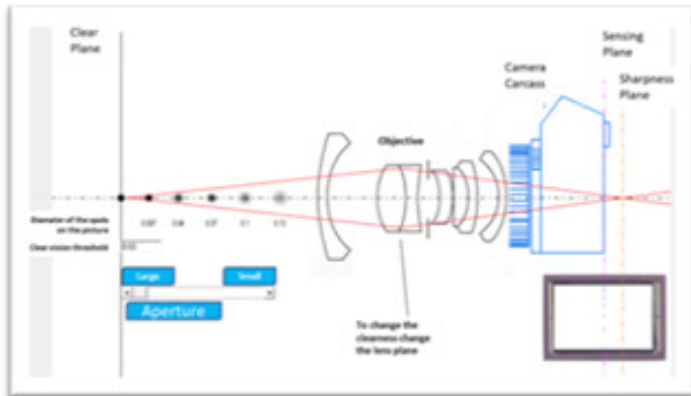


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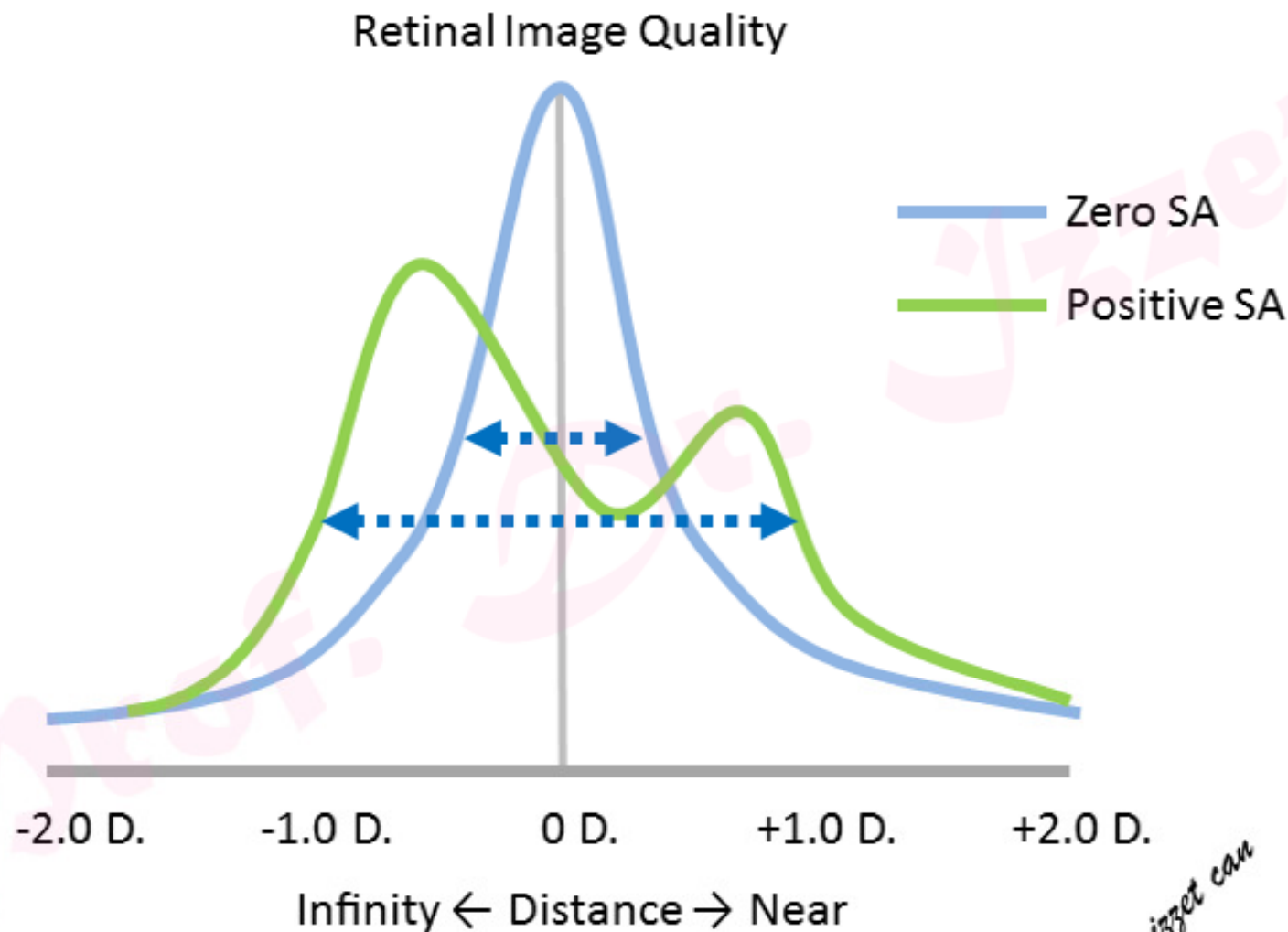
how can you increase depth of focus?

- Strategies
 - small aperture (pinhole effect)
 - Increased optical aberrations
 - diffractive designs

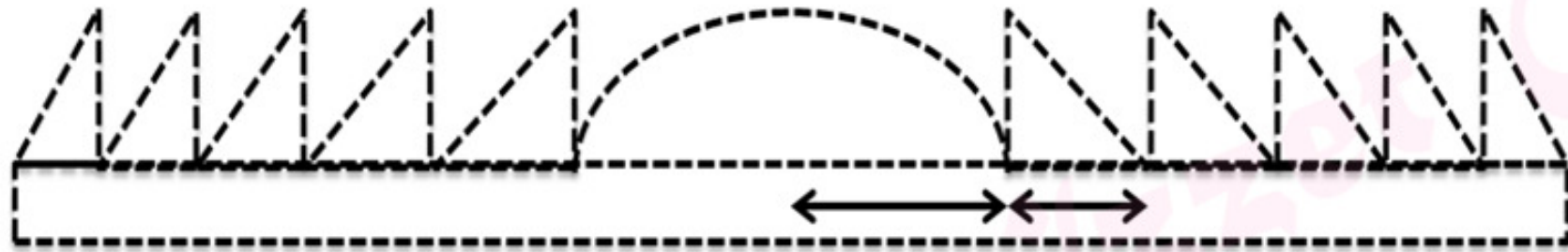
aperture effect



increased optical aberrations

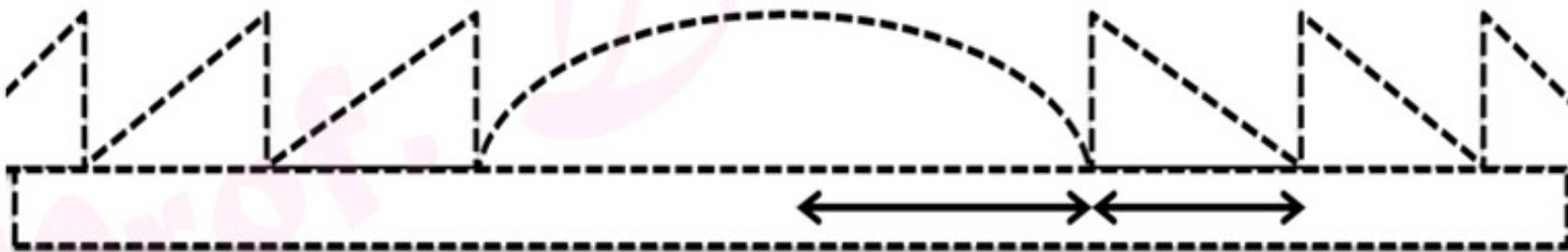


trifocality



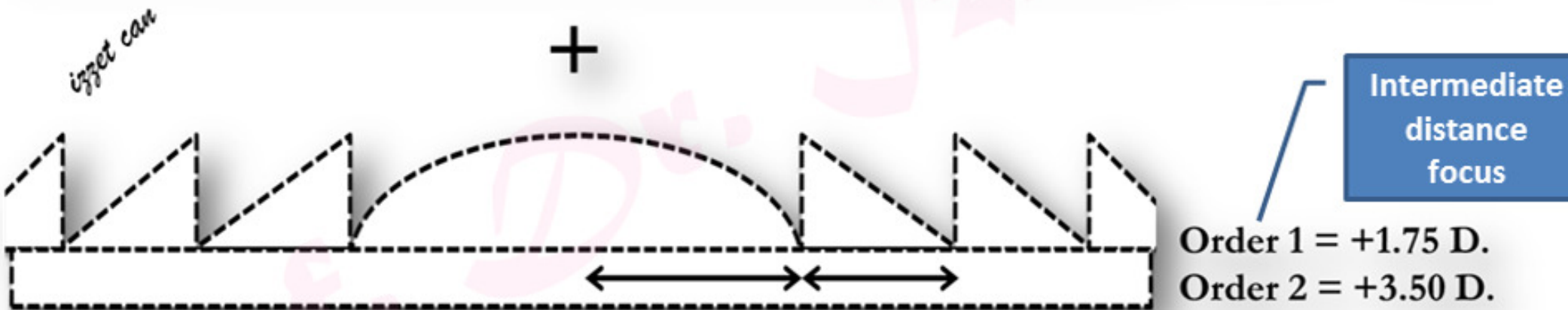
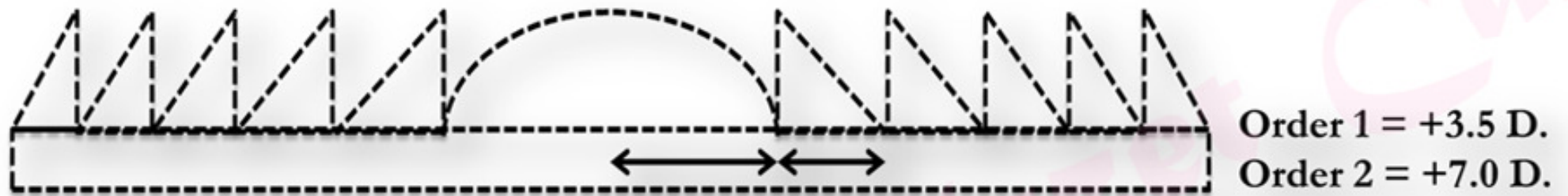
- Order 0 = no deviation → far
- Order 1 = +3.5 D. → near
- Order 2 = +7.0 D.

+



- Order 0 = no deviation → far
- Order 1 = +1.75 D. → intermediate
- Order 2 = +3.5 D. → near

trifocality



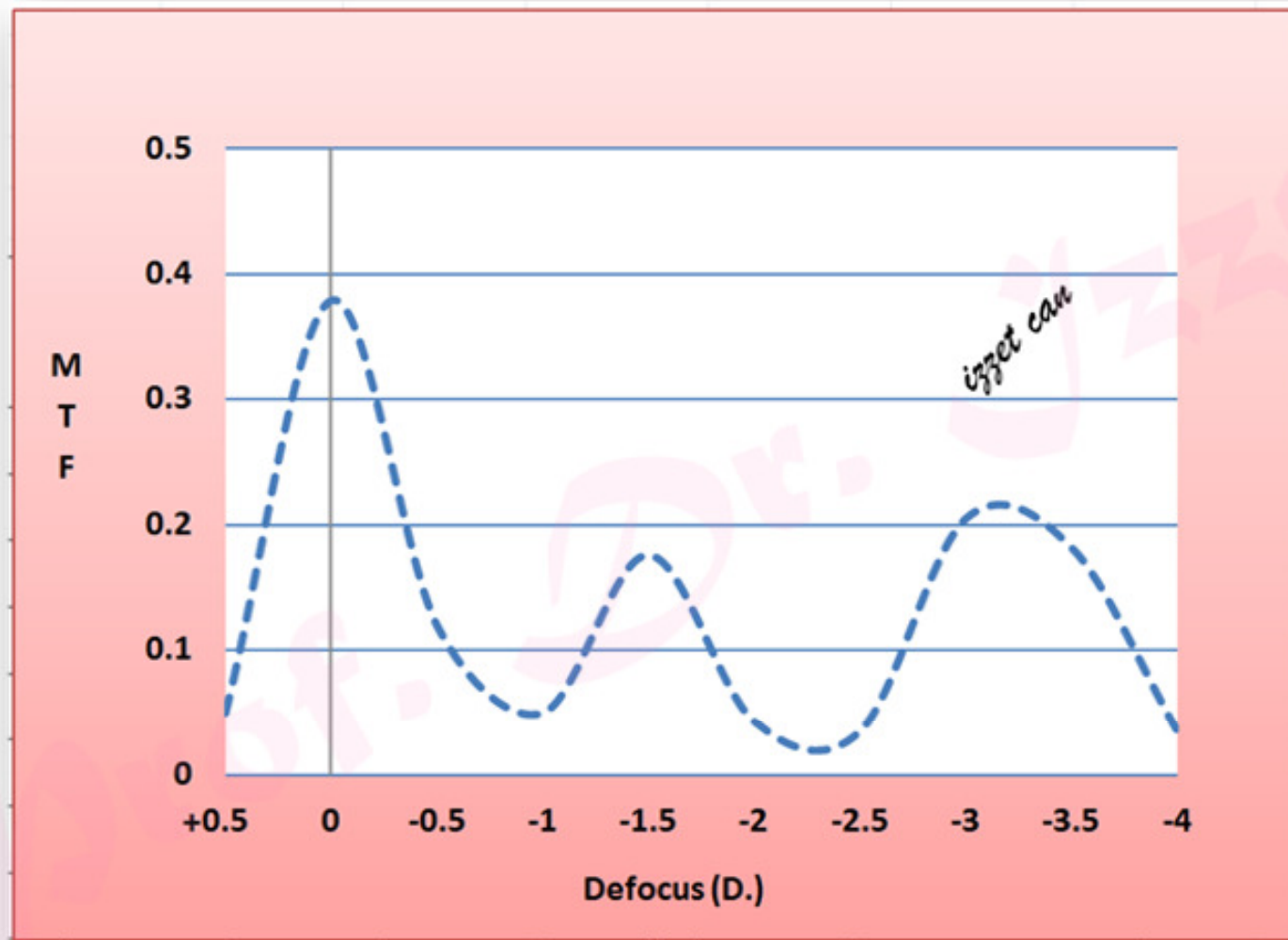
Summary:

There are 2 distant focuses : Both order 0

There are 2 near focuses (+3.5 D.): 1st kinoform's order 1 + 2nd kinoform's order 2

There is 1 intermediate focus (+1.75 D.): 2nd kinoform's order 1

trifocality



TRIFOCAL
IOL

features of available trifocal IOLs

	FineVision	AT Lisa Tri 839 MP	Reviol Tri ED
Material	Hydrophilic	Hydrophobic surface, Hydrophilic	Hydrophobic surface, Hydrophilic
Optic Design	Trifocal convolution, Apodization	Trifocal-Bifocal hybrid	Seni-apodize, EDOF
MICS (< 1.8 mm)	OK	OK	OK
Asphericity (μm)	-0.11	-0.18	-0.18
Haptic Design	4 round	Plate	Plate
Light Partition	Far: 50% Intermediate: 17% Near: 33%	Far: 50% Intermediate: 20% Near: 30%	Far: 46% Intermediate: 25% Near: 29%
Energy loss (unfocused light rate)	15%	14.3%	10.9%
Near Add. (D.)	+3.50 (36 cm)	+3.33 (40 cm)	+3.0 (42 cm)
Intermediate Add (D.)	+1.75 (60 cm)	+1.66 (76 cm)	+1.50 (80 cm)
Short Wavelength Filtration	UV + Blue	UV	UV + Purple

features of available trifocal IOLs

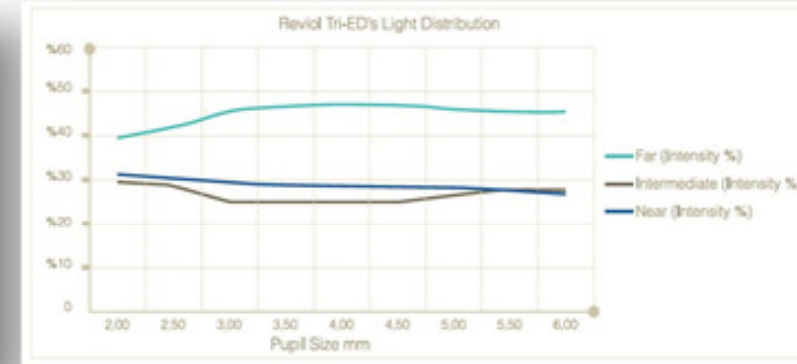
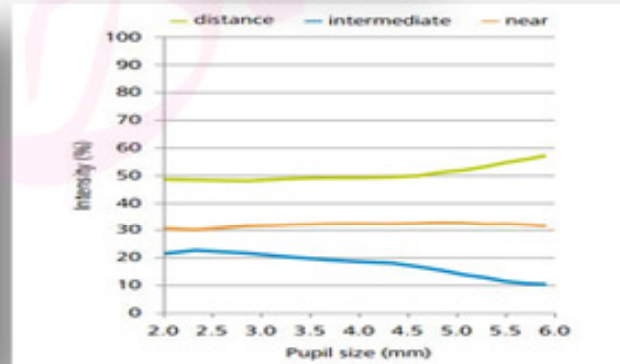
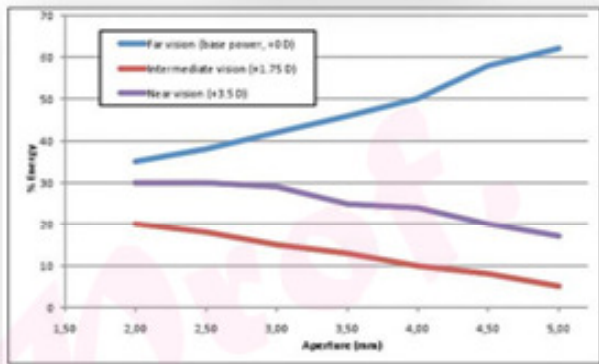
FineVision



AT Lisa Tri 839 MP



Reviol Tri ED



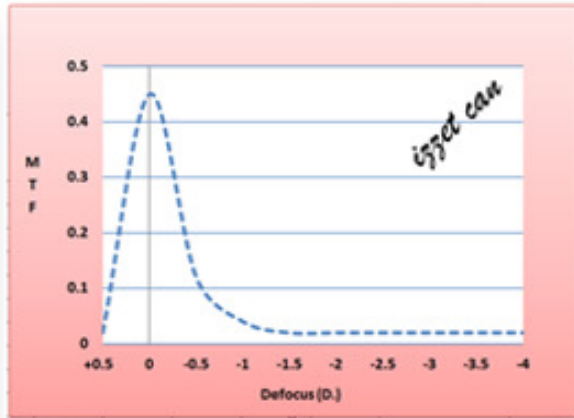
FineVision

AT Lisa Tri 839-MP

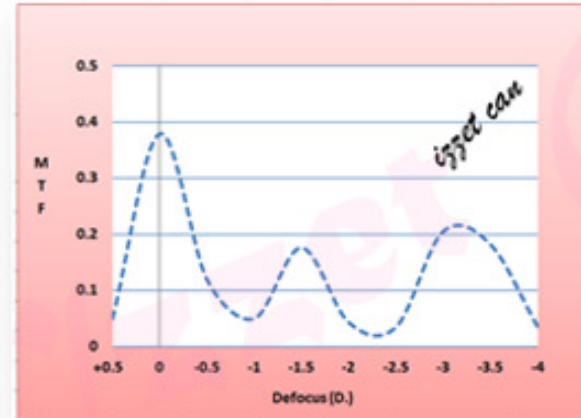
Reviol Tri-ED

* Data on file: First Clinical Findings. ** Comparison of a bifocal and a trifocal intraocular lens. E.Law R. Aggarwal H. Kasaby. Free Paper Session ESRCs 2014 London. *** Diffractive multifocal IOLs: a comparative study of Finevision versus ReSTOR 2.5 and 3.0D. K.Gundersen. Free Paper Session ESRCs 2014 London.

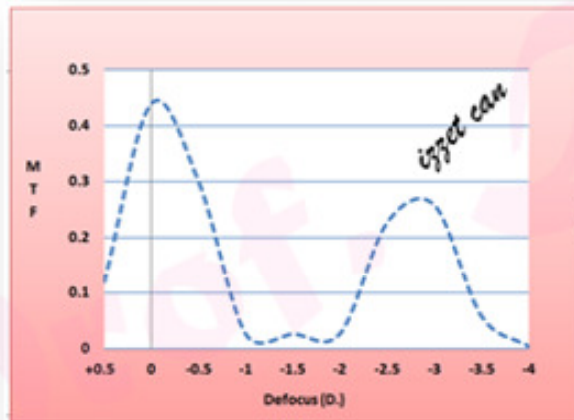
summary



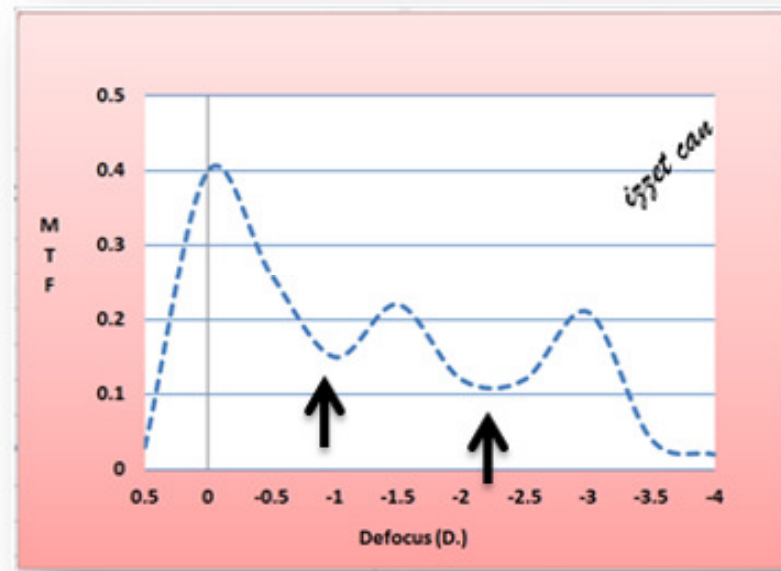
MONOFOCAL
IOL



TRIFOCAL
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TRIFOCAL
IOL
with EDof

Thank You Very Much For
Your Kind Attention