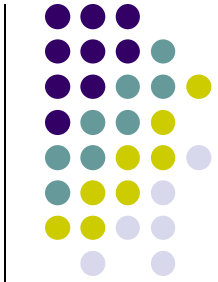
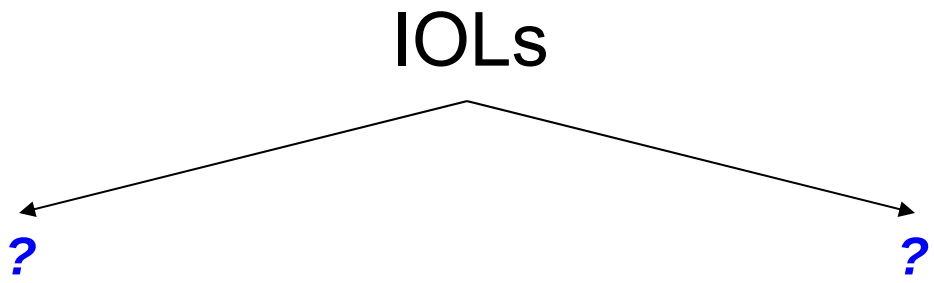


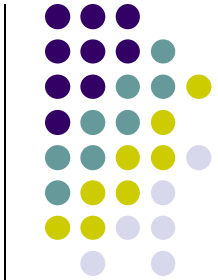
IOLs

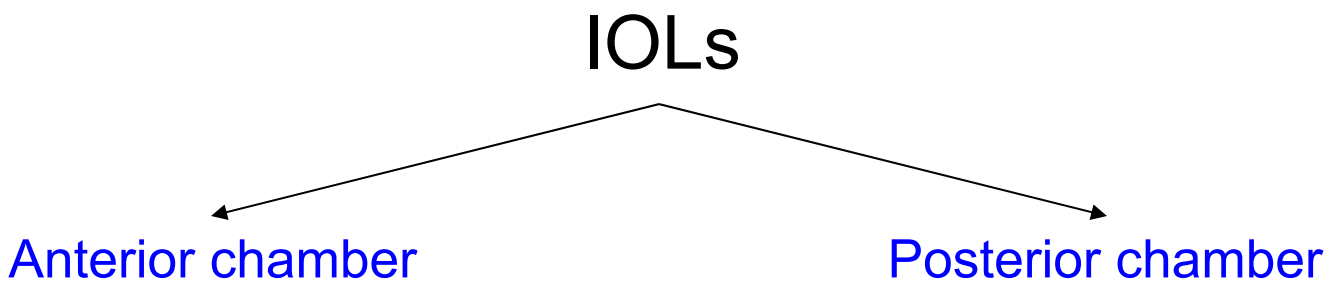
There are any number of ways we can think about/categorize IOLs.



There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

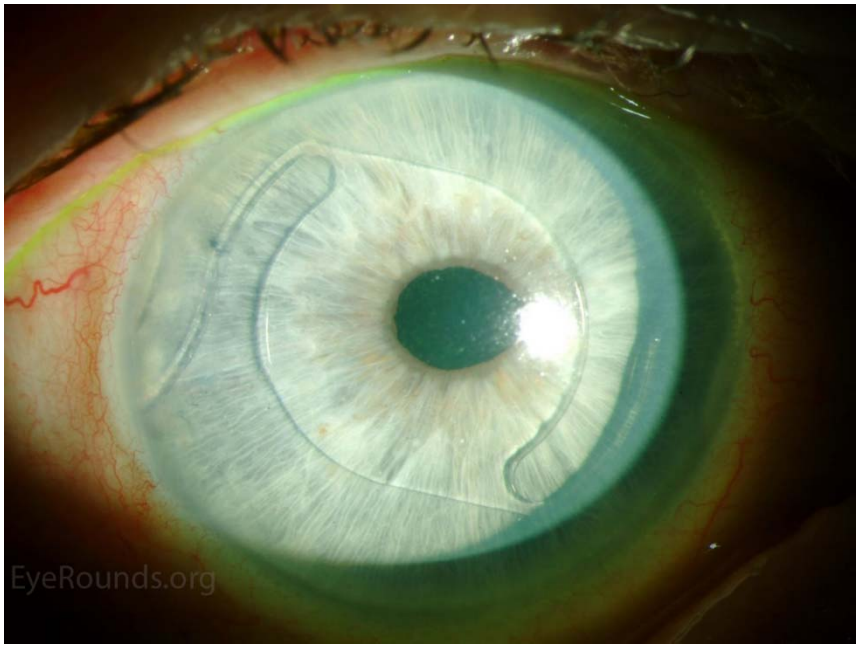
Location within the eye





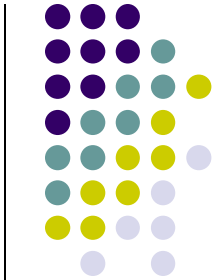
There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

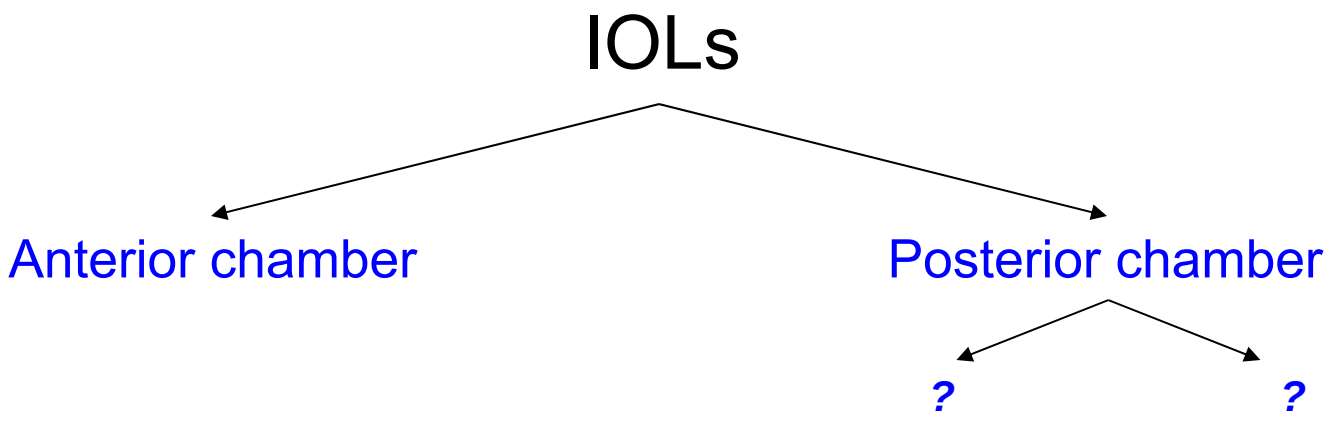
Location within the eye



Anterior chamber IOL

Posterior chamber IOL

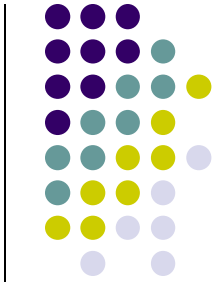


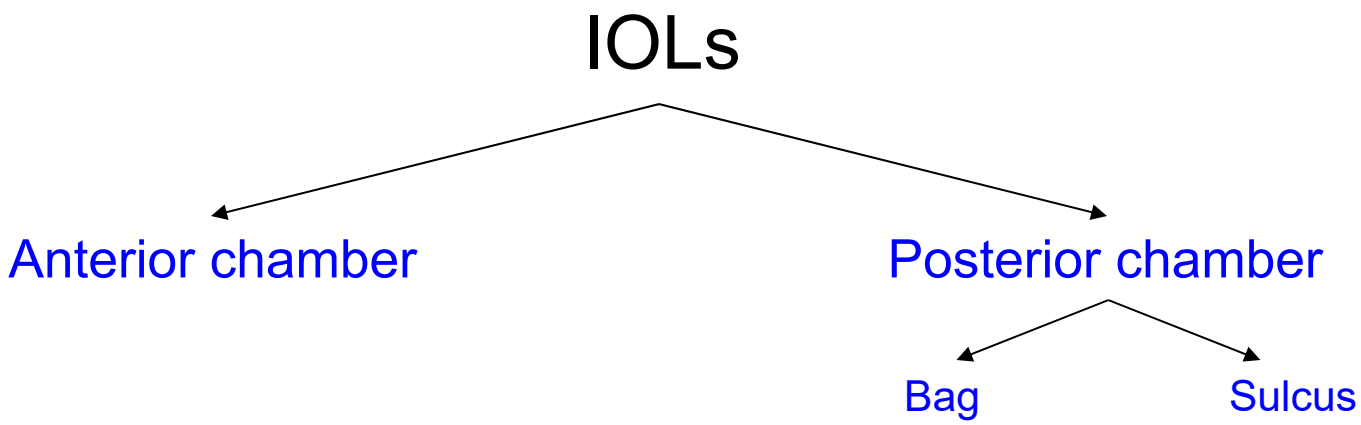


There are two distinct locations in the posterior chamber within which an IOL can be placed—what are they?
--?
--?

There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Location within the eye





There are two distinct locations in the posterior chamber within which an IOL can be placed—what are they?
--The capsular bag
--The ciliary sulcus

There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Location within the eye

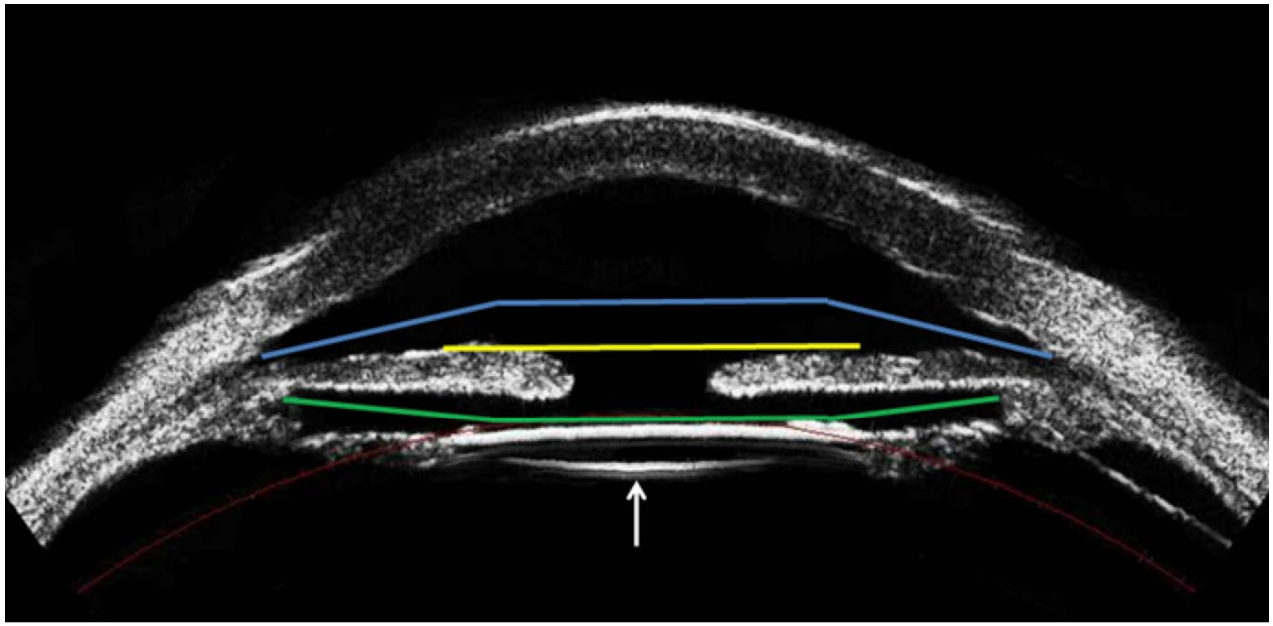
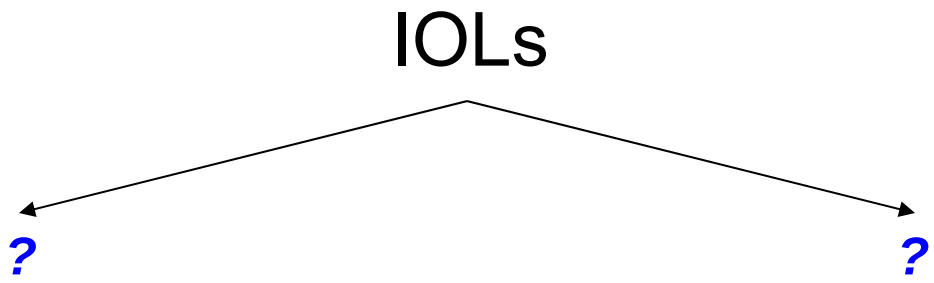
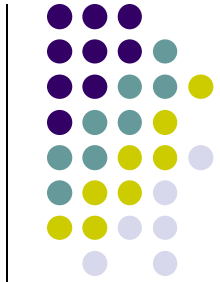


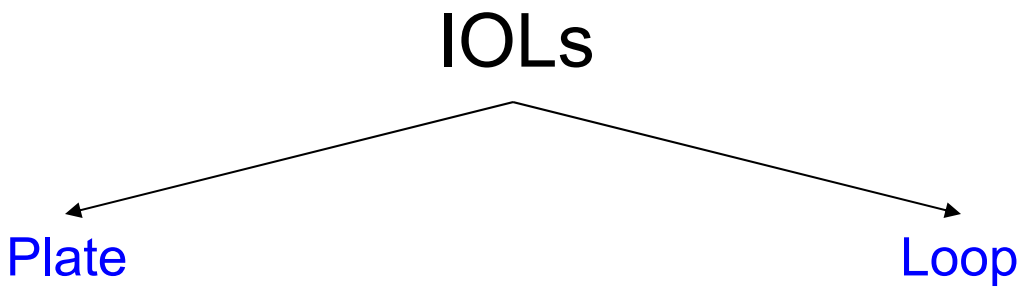
Figure 2: High-frequency ultrasound scan of the anterior segment of a human eye containing an IOL fixated within the capsular bag (arrow). The colored lines indicate the other sites where an IOL can be fixated in the anterior and posterior chambers. Blue: Anterior chamber angle. Yellow: Iris. Green: Ciliary sulcus.



There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

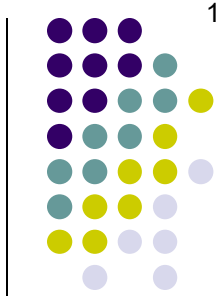
Haptic type





There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Haptic type



IOLs

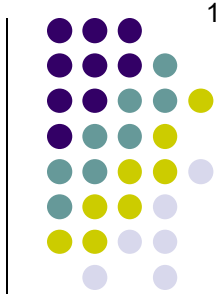
Plate

Loop

'Loop' *sounds like a closed structure. Is this the case?*

There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Haptic type



IOLs

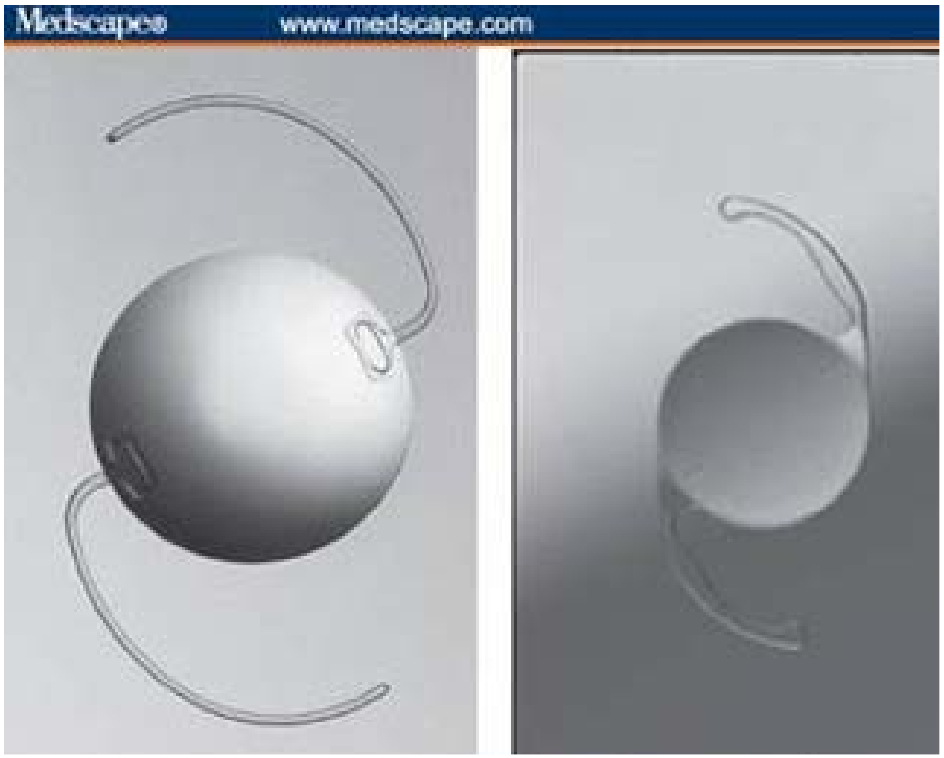
Plate

Loop

'Loop' *sounds like a closed structure. Is this the case?*
No. Most so-called 'loop' haptics are *J*- or *C*-shaped—so-called 'open' loops.

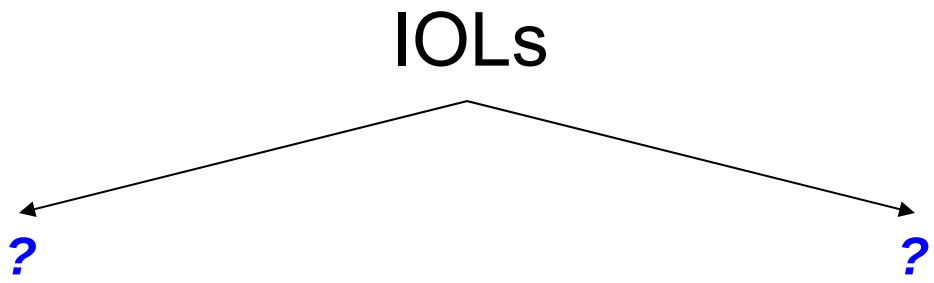
There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Haptic type



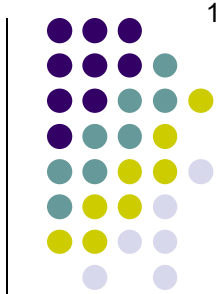
Loop-style IOLs

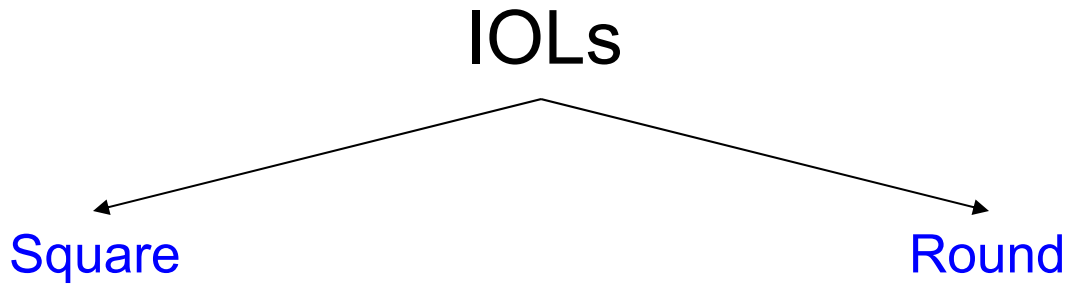
Plate-style IOL



There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic edge shape





There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic edge shape

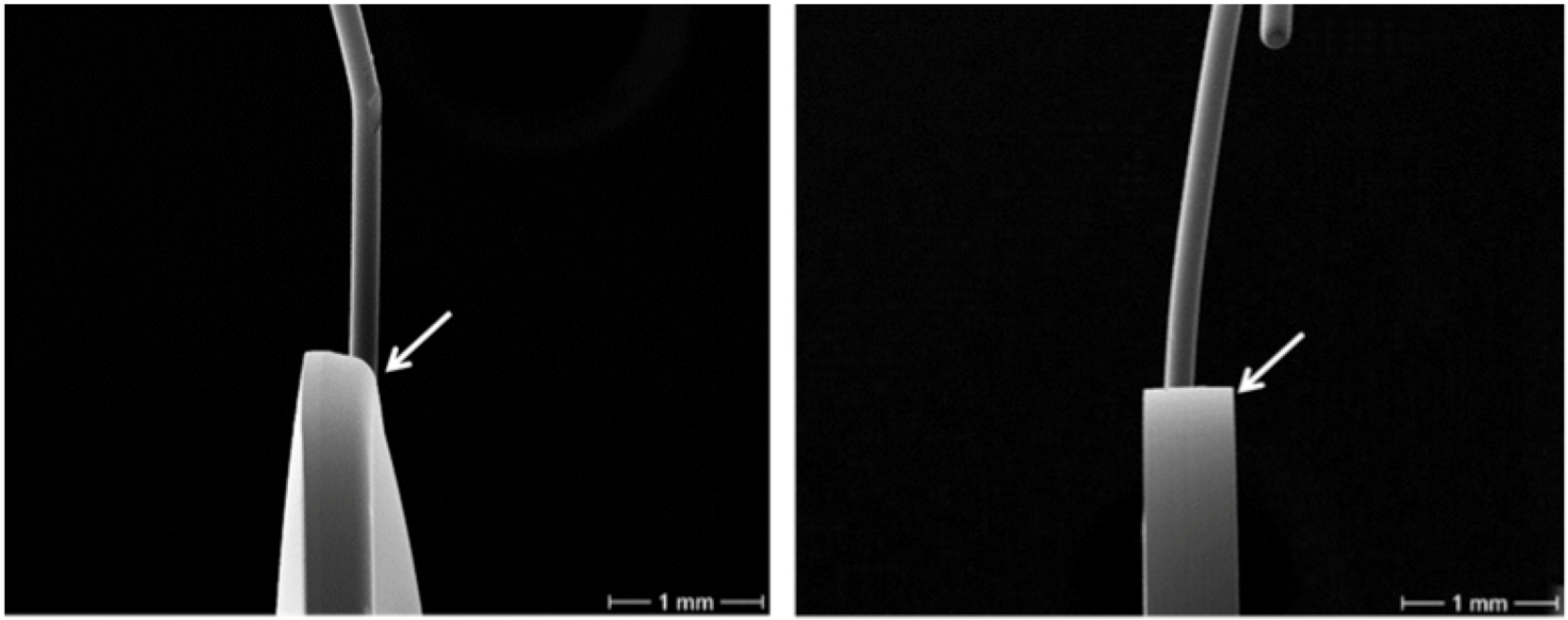
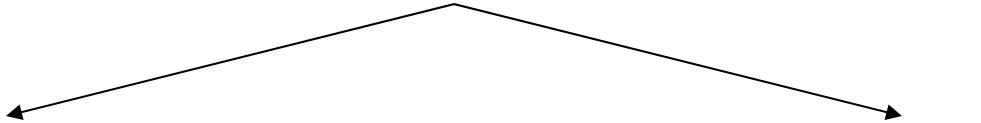


Figure 6: Scanning electron photomicrographs of two types of 3-piece hydrophobic acrylic IOLs. The arrows show the anterior optic edge of the lenses. A) Round edge. B) Square edge.

IOLs



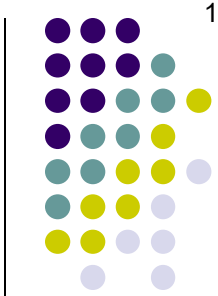
Square

Round

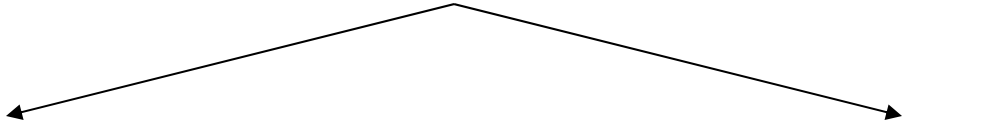
What is the benefit of a square-edged optic?

There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic edge shape



IOLs



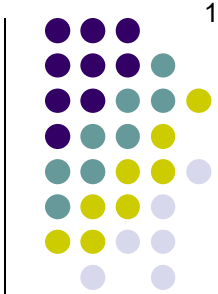
Square

Round

What is the benefit of a square-edged optic?
It reduces the likelihood of abb. development

There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic edge shape



IOLs

Square

Round

What is the benefit of a square-edged optic?
It reduces the likelihood of PCO development

There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic edge shape

IOLs

Square

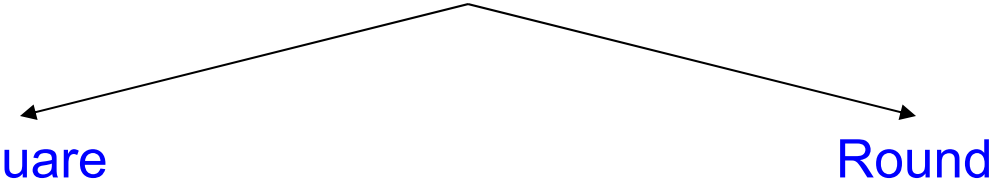
Round

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does PCO *stand for in this context?*

ize IOLs.
o:

IOLs



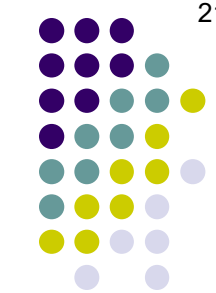
Square

Round

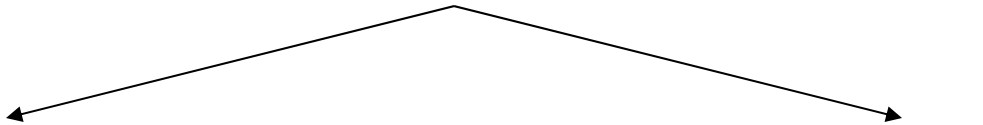
What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does PCO *stand for in this context?*
Posterior capsular opacification

ize IOLs.
o:



IOLs



Square

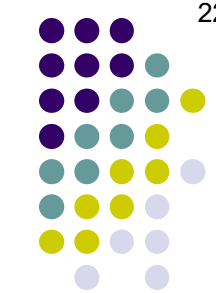
Round

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

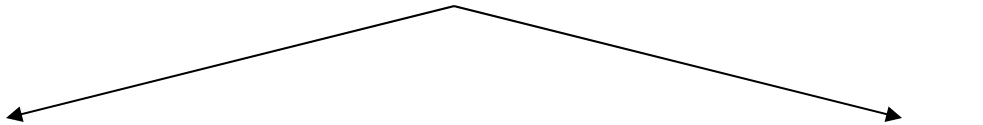
What does PCO *stand for in this context?*
Posterior capsular opacification

Briefly, what is a PCO?

ize IOLs.
o:



IOLs



Square

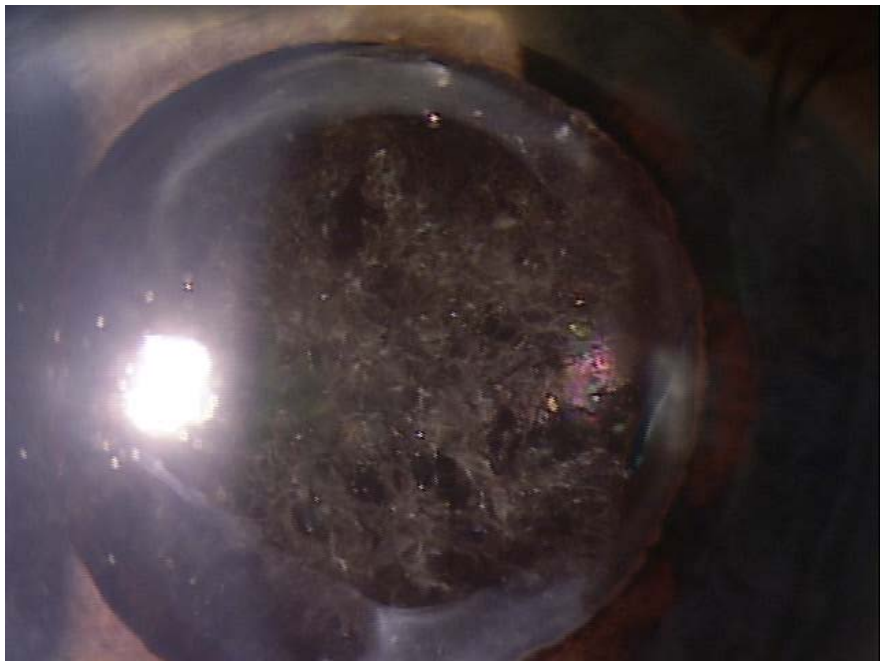
Round

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

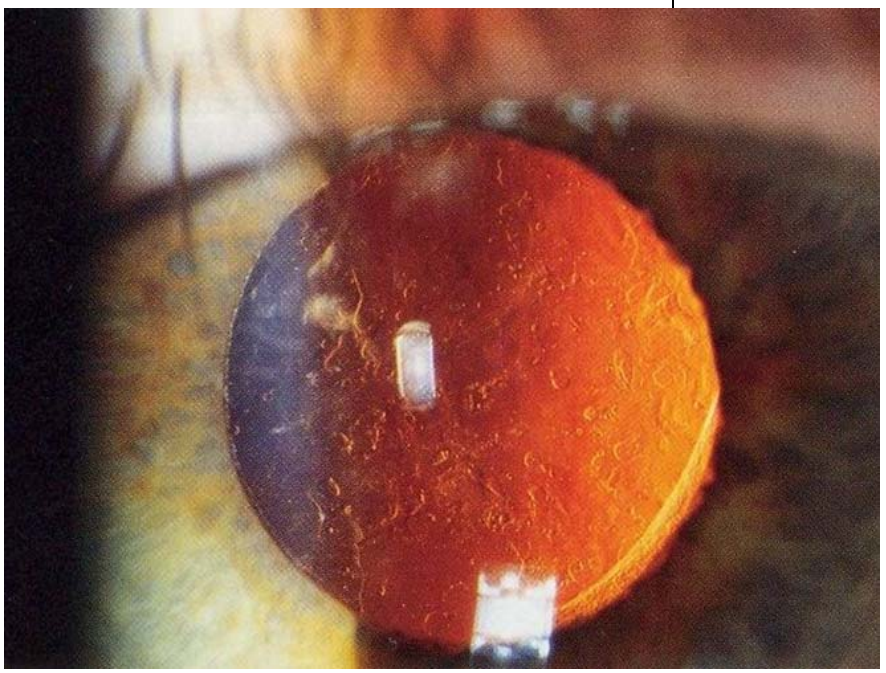
What does PCO *stand for in this context?*
Posterior capsular opacification

Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule. These opacities can be visually and/or medically significant if they are located in or near the visual axis.

ize IOLs.
o:

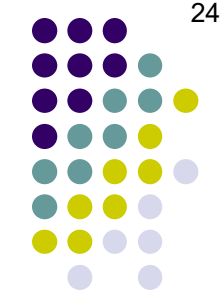


Direct illumination

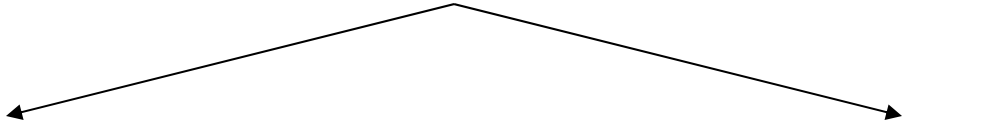


Retroillumination

PCO



IOLs



Square

Round

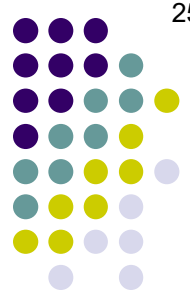
What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does PCO *stand for in this context?*
Posterior capsular opacification

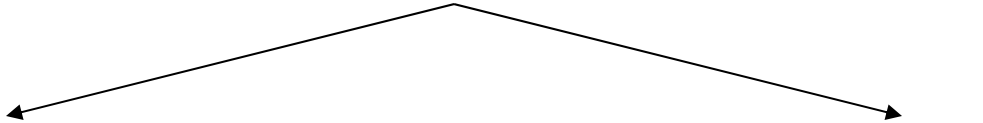
Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule.
These opacities can be visually and/or medically significant if they are located

ize IOLs.

What is the origin of these opacities?



IOLs



Square

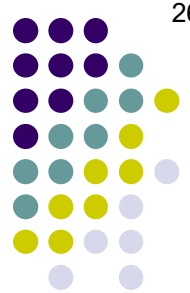
Round

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does PCO stand for in this context?
Posterior capsular opacification

Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule.

What is the origin of these opacities?
Even after the most thorough cortical cleanup, viable lens epithelial cells remain in the bag. These cells can proliferate and migrate, including into the central or paracentral posterior capsule, in which case a clinically significant PCO may result.



IOLs

Square

Round

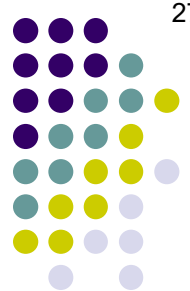
What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does PCO stand for in this context?
Posterior capsular opacification

Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule.

What is the origin of these opacities?
Even after the most thorough cortical cleanup, v
These cells can proliferate and migrate, inclu
capsule, in which case a clinically significant PC

Sometimes these cells get swole, in which case they are referred to by one of two names—what are they?



IOLs

Square

Round

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does PCO stand for in this context?
Posterior capsular opacification

Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule.

What is the origin of these opacities?
These cells can proliferate and migrate

Sometimes these cells get swole, in which case they are referred to by one of two names—what are they?
Wedl or **bladder** cells

IOLs

Square

Round

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

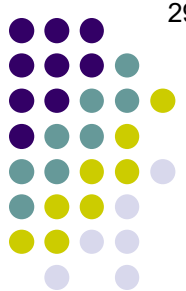
What does PCO stand for in this context?
Posterior capsular opacification

Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule.

What is the origin of these opacities?
These cells can proliferate and migrate

Sometimes these cells get swole, in which case they are referred to by one of two names—what are they?
Wedl or **bladder** cells

Wedl cells can form globular opacities. By what lapidary-related name are these opacities known?



IOLs

Square

Round

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does PCO stand for in this context?
Posterior capsular opacification

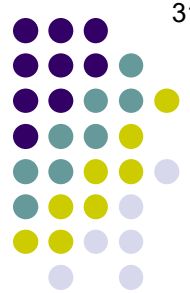
Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule.

What is the origin of these opacities?
These cells can proliferate and migrate

Sometimes these cells get swole, in which case they are referred to by one of two names—what are they?
Wedl or **bladder** cells

Wedl cells can form globular opacities. By what lapidary-related name are these opacities known?
Elschnig pearls

Elschnig pearls



IOLs

Square

Round

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does PCO stand for in this context?
Posterior capsular opacification

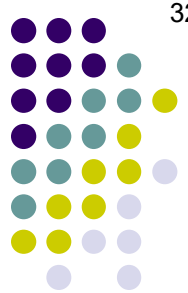
Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule.

What is the origin of these opacities?
These cells can proliferate and migrate

Sometimes these cells get swole, in which case they are referred to by one of
Wedl or **bladder** cells

These globular opacities are said to resemble what pisciform situation?

Wedl cells can form ***globular opacities****. By what lapidary-related name are these opacities known?*
Elschnig pearls



IOLs

Square

Round

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does PCO stand for in this context?
Posterior capsular opacification

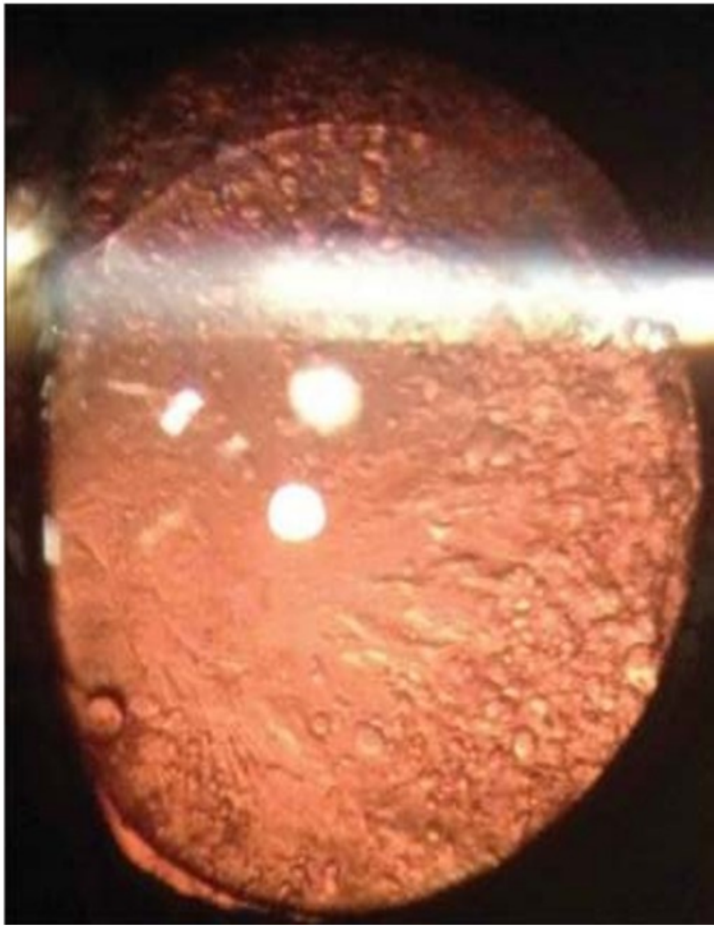
Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule.

What is the origin of these opacities?
Even after the most thorough cortical cleanup, **These cells can proliferate and migrate**, capsule, in which case a clinically significant PC

Sometimes these cells get swole, in which case they are referred to by one of
Wedl or **bladder** cells

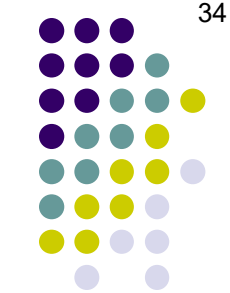
These globular opacities are said to resemble what pisciform situation?
'Fish eggs'

*Wedl cells can form **globular opacities**. By what lapidary-related name are these opacities known?*
Elschnig pearls



Elschnig pearls

Fish eggs



IOLs

On occasion, the cells will fill the peripheral portion of the bag where the anterior and posterior capsules touch. What is this finding called?

What is the benefit of a square edged optic?
It reduces the likelihood of **PCO** development

What does P stand for in this context?
Posterior cap ar opacification

Briefly, what is PCO?
A late post-C ccurrence in which opacities develop on the posterior capsule.

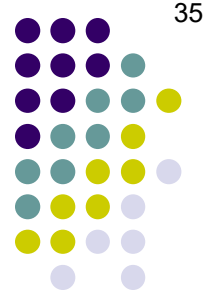
What is the origin these opacities?
Even after the most thorough cortical cleanup, v
capsule, in which case a clinically significant PC
These cells can proliferate and migrate, inclu

Sometimes these cells get swole, in which case they are referred to by one of
Wedl or **bladder** cells

These globular opacities are said to resemble what pisciform situation?
'Fish eggs'

*Wedl cells can form **globular opacities**. By what lapidary-related name are these opacities known?*
Elschnig pearls

N e x t Q



IOLs

On occasion, the cells will fill the peripheral portion of the bag where the anterior and posterior capsules touch. What is this finding called?
Soemmering ring

What is the benefit of a square-edged optic?
It reduces the likelihood of **PCO** development

What does PCO stand for in this context?
Posterior capsular opacification

Briefly, what is PCO?
A late post-C[illegible]ccurrence in which opacities develop on the posterior capsule.

What is the origin[illegible] these opacities?
Even after the most thorough cortical cleanup, [illegible]
These cells can proliferate and migrate, [illegible]
capsule, in which case a clinically significant PC[illegible]

Sometimes these cells get swole, in which case they are referred to by one of **Wedl** or **bladder** cells

These globular opacities are said to resemble what pisciform situation?
'Fish eggs'

*Wedl cells can form **globular opacities**. By what lapidary-related name are these opacities known?*
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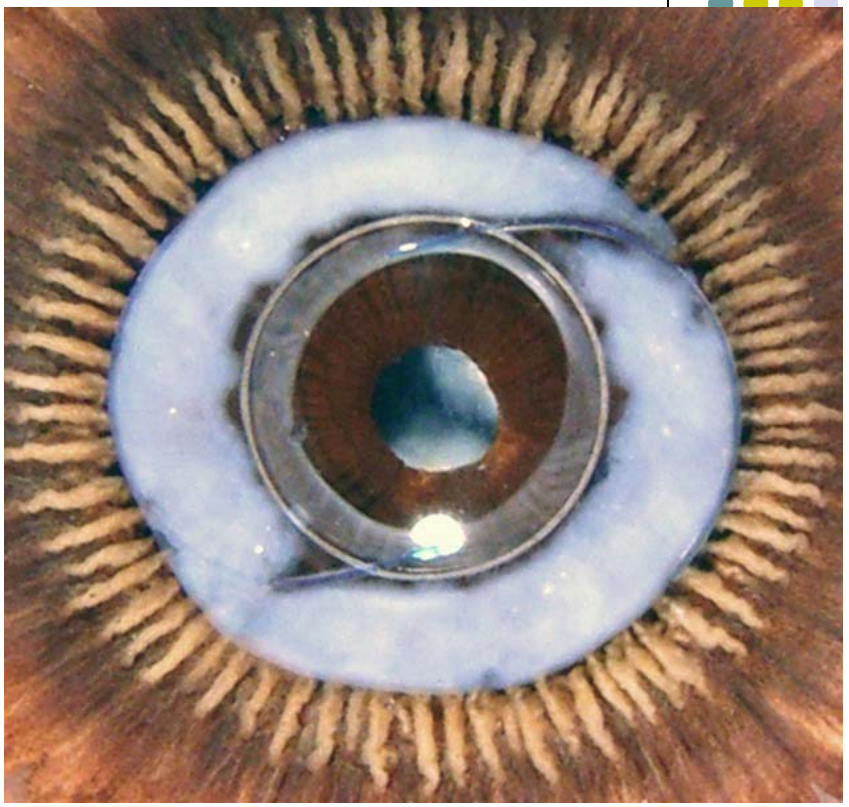
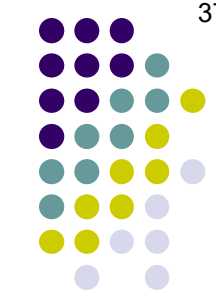
Next Q

In vivo



Post mortem posterior view

Soemmering ring



IOLs

Square

Round

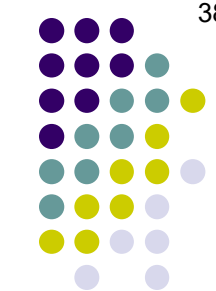
What is the benefit of a square-edged optic?
It reduces the likelihood of **PCO** development

What does PCO *stand for in this context?*
Posterior capsular opacification

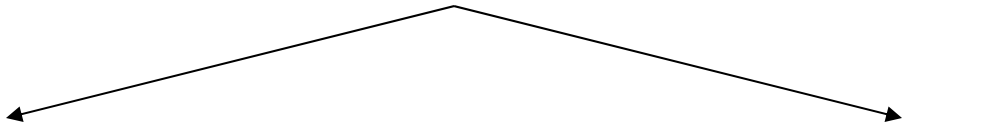
Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule. These opacities can be visually and/or medically significant if they are located in or near the visual axis.

How does a square-edged optic prevent PCO development?

ize IOLs.
o:



IOLs



Square

Round

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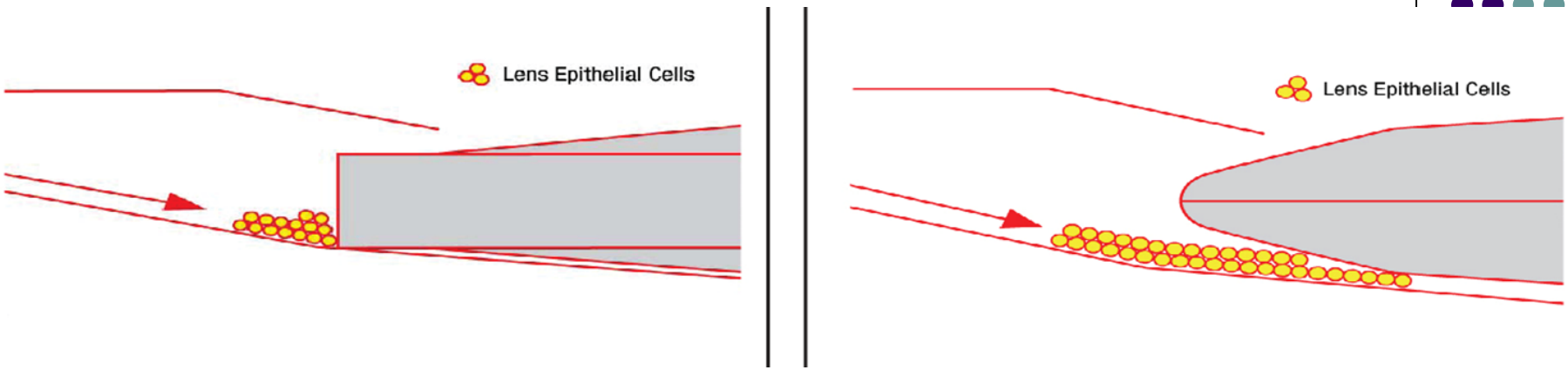
What does PCO *stand for in this context?*
Posterior capsular opacification

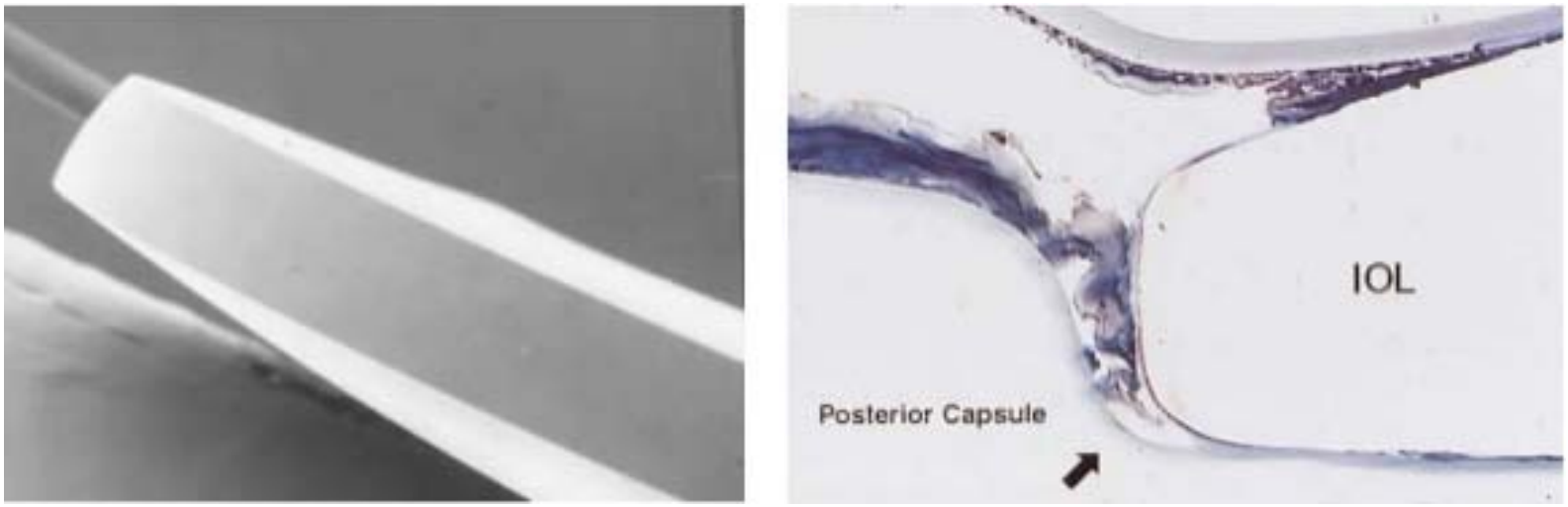
Briefly, what is a PCO?
A late post-CE occurrence in which opacities develop on the posterior capsule. These opacities can be visually and/or medically significant if they are located in or near the visual axis.

How does a square-edged optic prevent PCO development?
The squared edge acts as a physical barrier to the migration of the cells that give rise to it

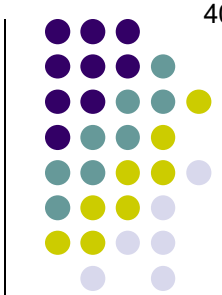
ize IOLs.
o:



Note how the square edge blocks the ingress of the PCO



PCO development and optic edge shape



IOLs

Square

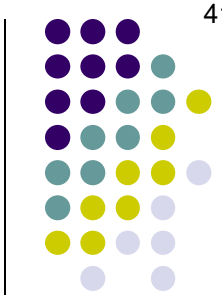
Round

What is the benefit of a square-edged optic?
It reduces the likelihood of PCO development

What is the benefit of a ***round****-edged optic?*

There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic edge shape



IOLs

Square

Round

What is the benefit of a square-edged optic?
It reduces the likelihood of PCO development

What is the benefit of a ***round****-edged optic?*
It is associated with a lower risk of

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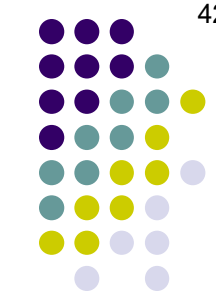


IOLs

Square

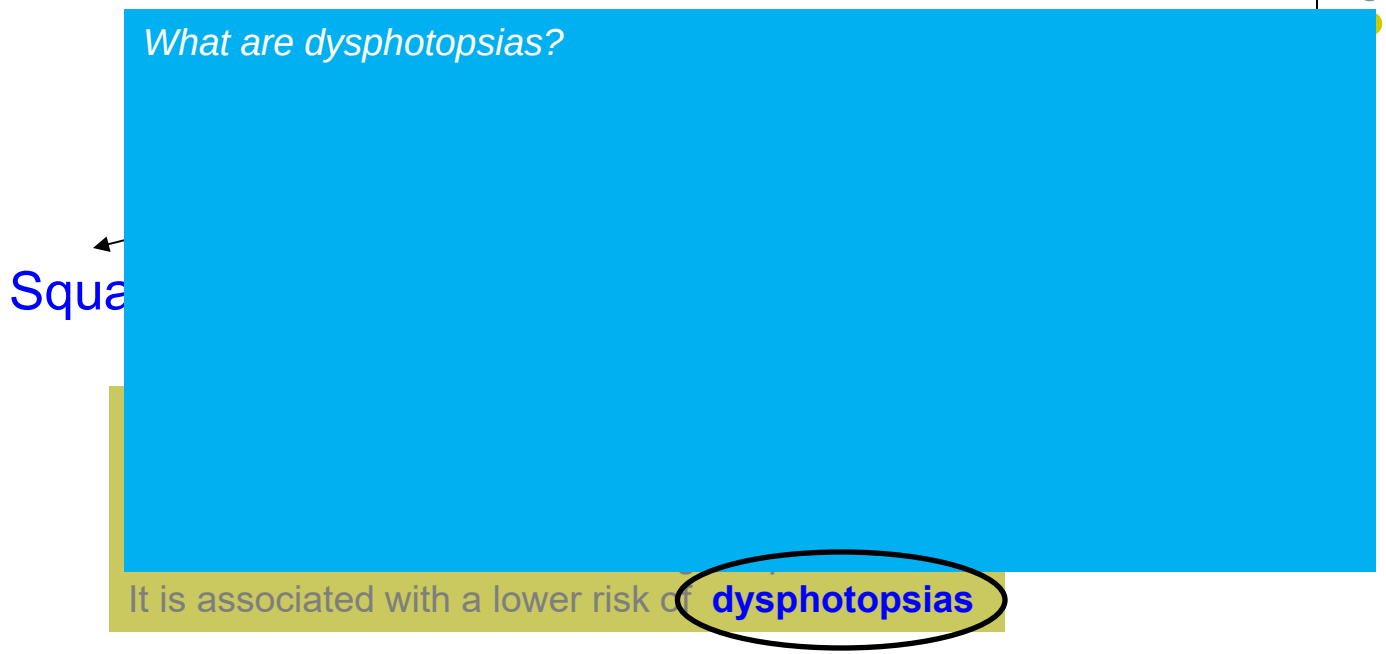
Round

What is the benefit of a square-edged optic?
It reduces the likelihood of PCO development

What is the benefit of a ***round****-edged optic?*
It is associated with a lower risk of dysphotopsias

There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic edge shape



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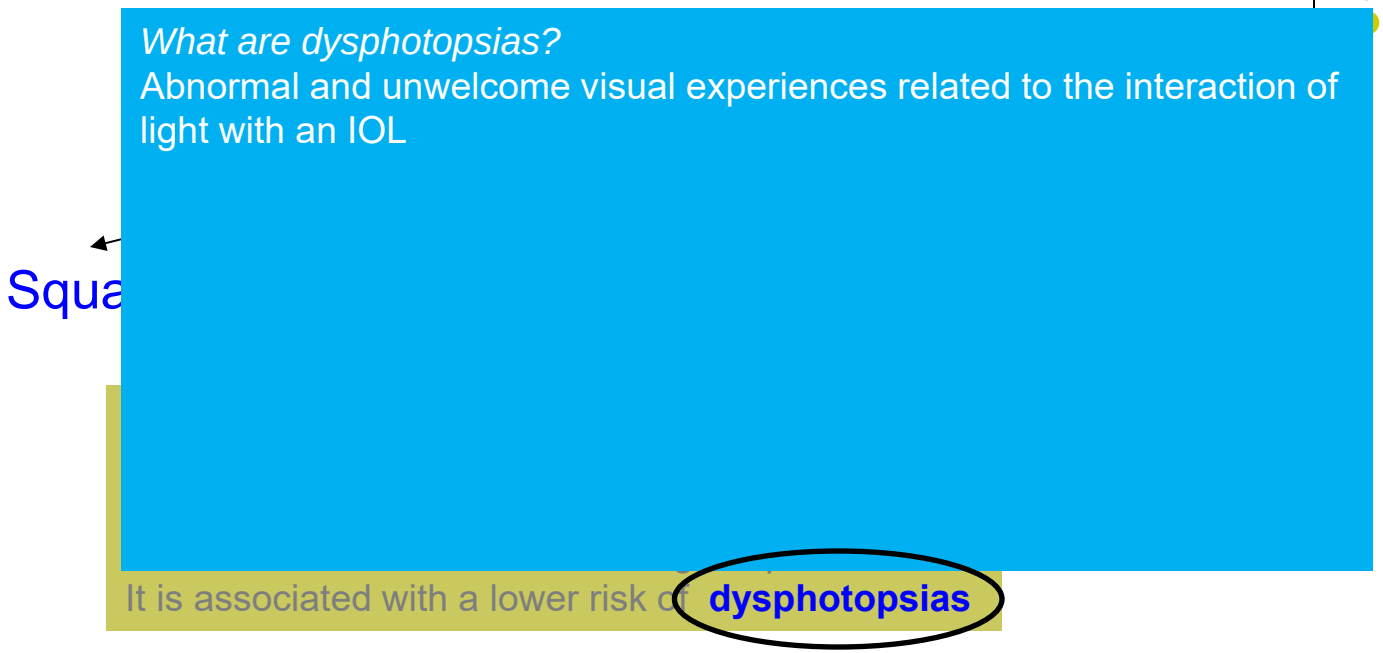

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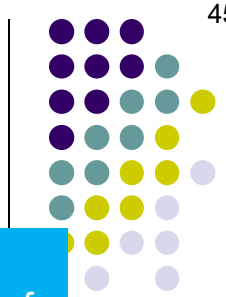

What are dysphotopsias?
Abnormal and unwelcome visual experiences related to the interaction of light with an IOL

There are two classes of dysphotopsias—what are they?

Squa

It is associated with a lower risk of **dysphotopsias**

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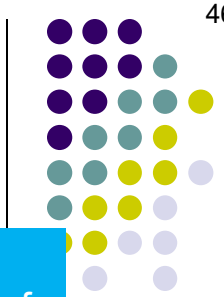

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There are two classes of dysphotopsias—what are they?
Positive dysphotopsias and negative dysphotopsias

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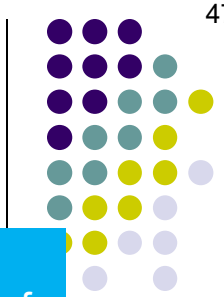

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Abnormal and unwelcome visual experiences related to the interaction of light with an IOL

There are two classes of dysphotopsias—what are they?
Positive dysphotopsias and negative dysphotopsias

In what fundamental way do positive and negative dysphotopsias differ?

Squa

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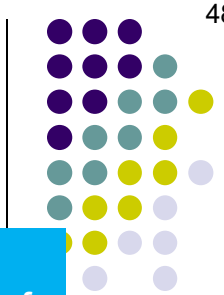

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There are two classes of dysphotopsias—what are they?
Positive dysphotopsias and negative dysphotopsias

In what fundamental way do positive and negative dysphotopsias differ?
Positive dysphotopsia involve the experience of unexpected light, eg, haloes, streaks, and flashes

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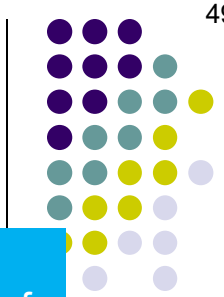

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There are two classes of dysphotopsias—what are they?
Positive dysphotopsias and negative dysphotopsias

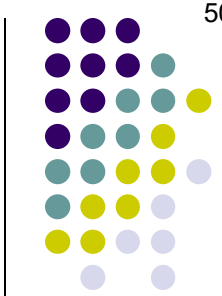
In what fundamental way do positive and negative dysphotopsias differ?
Positive dysphotopsia involve the experience of unexpected light, eg, haloes, streaks, and flashes; whereas
negative dysphotopsia involve the experience of unexpected **darkness**, often described as 'shadows'

Squa

It is associated with a lower risk of **dysphotopsias**

There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic edge shape



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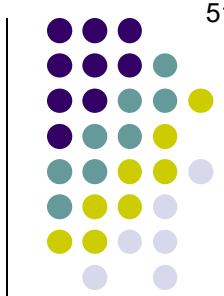
Haptic edge shape?

Is **haptic** *edge shape a thing?*



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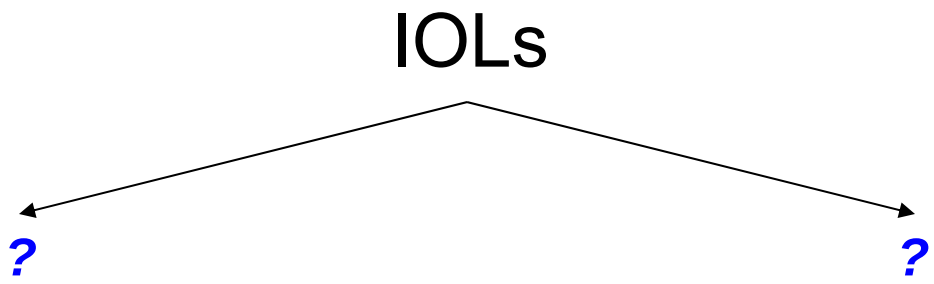
Is **haptic** *edge shape a thing?*
Indeed it is



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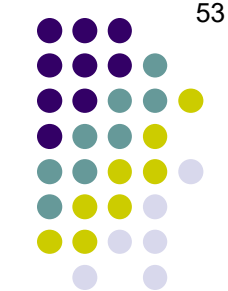
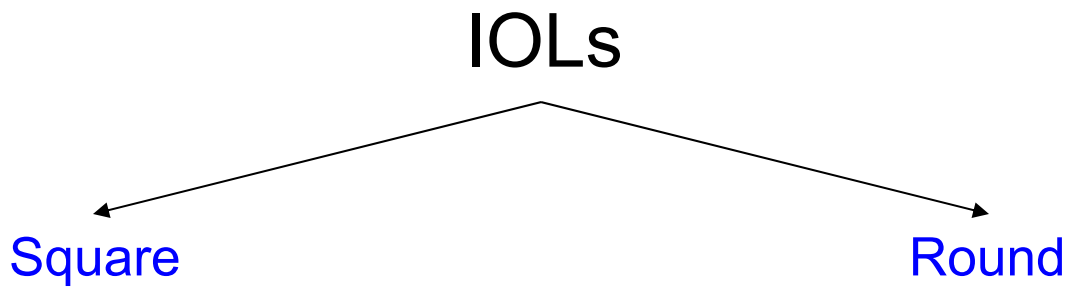
How do we divvy up haptic edge shape?





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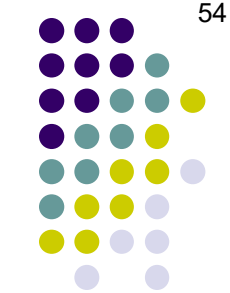
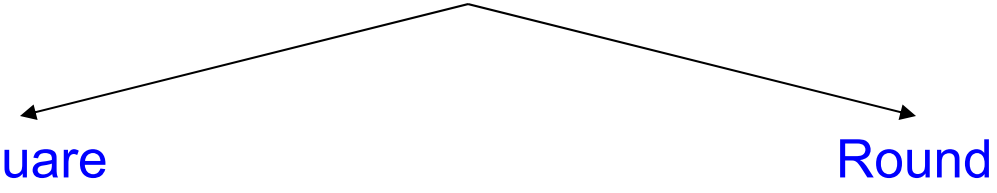
How do we divvy up haptic edge shape?
The same way—square vs round



IOLs



Square

Round

Which is better, square- or round haptics?

There are a egorize IOLs.
For example, we could divvy them up with respect to:

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Indeed it is

How do we divvy up haptic edge shape?
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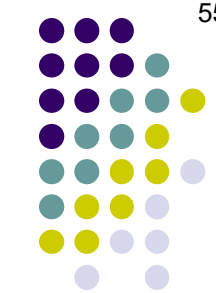

IOLs

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Which is better, square- or round haptics?
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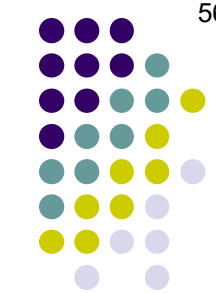

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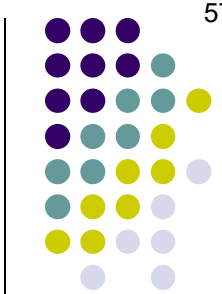
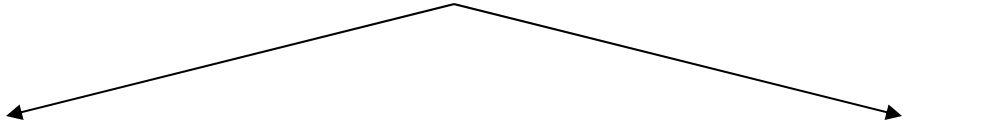


IOLs



Square

Round

Which is better, square- or round haptics?
That depends

Depends on what?
Depends on where the IOL is placed

There are a egorize IOLs.
For example, we could divvy them up with respect to:

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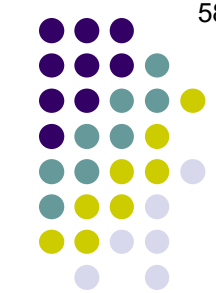
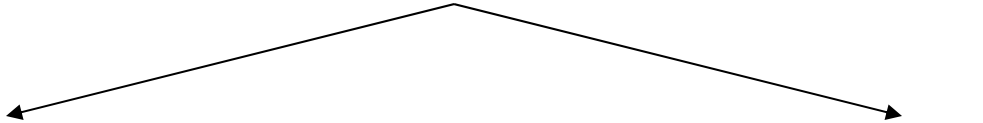


IOLs



Square

Round

Which is better, square- or round haptics?
That depends

Depends on what?
Depends on where the IOL is placed

In what location would each be the preferred shape?
Square is better if the IOL is in the
Round is better if the IOL is in the

There are a egorize IOLs.
For example, we could divvy them up with respect to:

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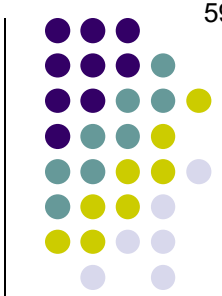
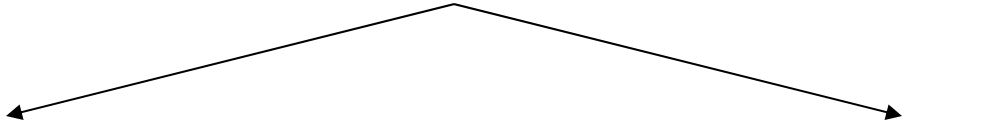


IOLs



Square

Round

Which is better, square- or round haptics?
That depends

Depends on what?
Depends on where the IOL is placed

In what location would each be the preferred shape?
Square is better if the IOL is in the **bag**
Round is better if the IOL is in the **sulcus**

There are a egorize IOLs.
For example, we could divvy them up with respect to:

Haptic edge shape!

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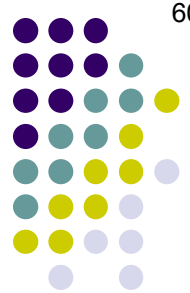
Indeed it is

How do we divvy up haptic edge shape?
The same way—square vs round



IOLs

Square

Round

Which is better, square- or round haptics?
That depends

Depends on what?
Depends on where the IOL is placed

Why is a round-edge haptic preferable for in-the-sulcus placement?

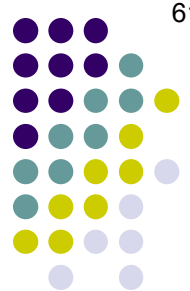
Square is better if the IOL is in the **bag**
Round is better if the IOL is in the **sulcus**

There are a[illegible]egorize IOLs.
For example, we could divvy them up with respect to:

Haptic edge shape!

Is **haptic** *edge shape a thing?*
Indeed it is

How do we divvy up haptic edge shape?
The same way—square vs round



IOLs

Square

Round

Which is better, square- or round haptics?
That depends

Depends on what?
Depends on where the IOL is placed

Why is a round-edge haptic preferable for in-the-sulcus placement?
Because compared to a square-edge design, it reduces the risk of two words

Square is better if the IOL is in the **bag**

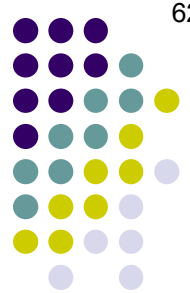
Round is better if the IOL is in the **sulcus**

There are a[illegible]egorize IOLs.
For example, we could divvy them up with respect to:

Haptic edge shape!

Is **haptic** *edge shape a thing?*
Indeed it is

How do we divvy up haptic edge shape?
The same way—square vs round



IOLs

Square

Round

Which is better, square- or round haptics?
That depends

Depends on what?
Depends on where the IOL is placed

Why is a round-edge haptic preferable for in-the-sulcus placement?
Because compared to a square-edge design, it reduces the risk of iris chafing

Square is better if the IOL is in the **bag**

Round is better if the IOL is in the **sulcus**

There are a[illegible]egorize IOLs.
For example, we could divvy them up with respect to:

Haptic edge shape!

Is **haptic** *edge shape a thing?*
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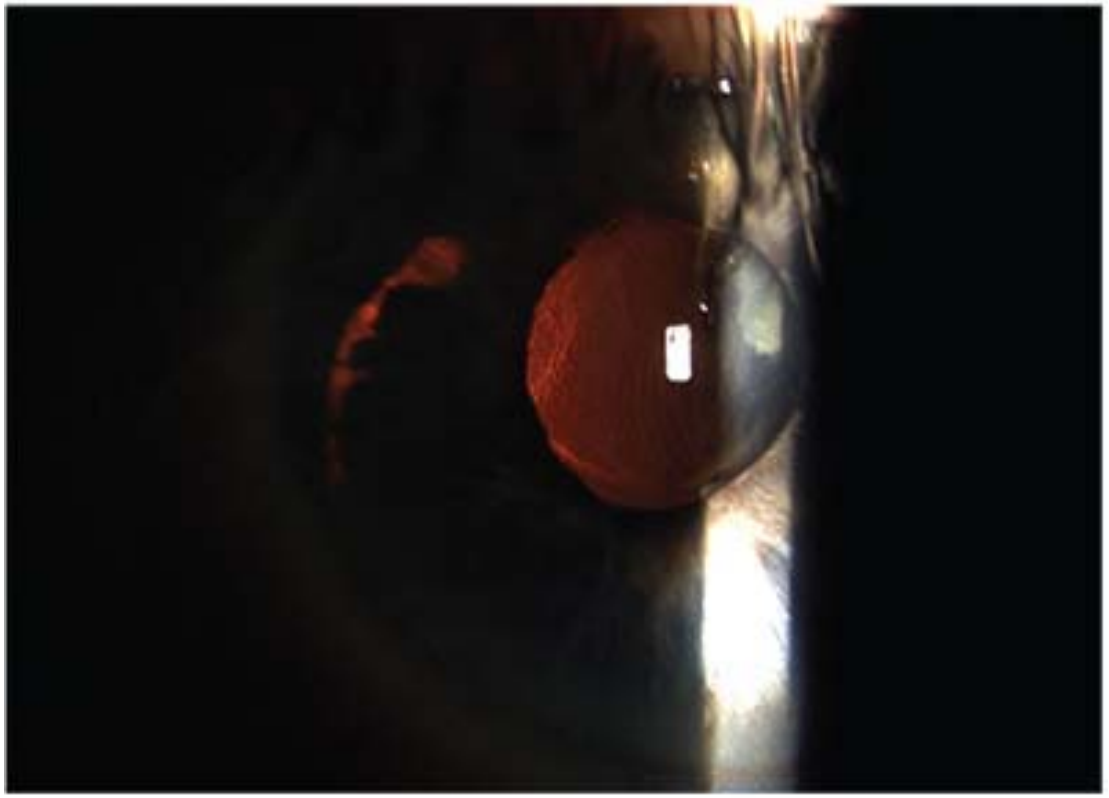
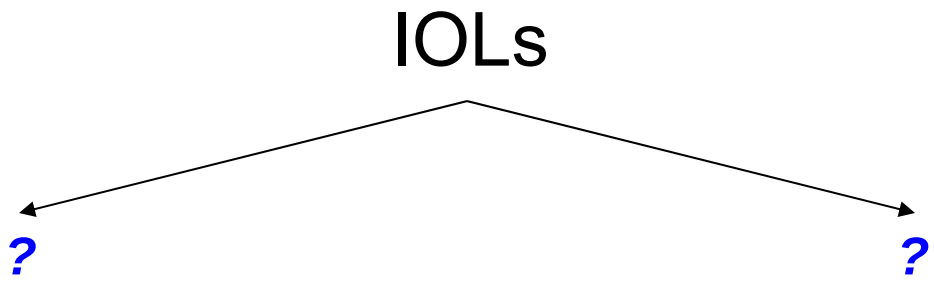
How do we divvy up haptic edge shape?
The same way—square vs round

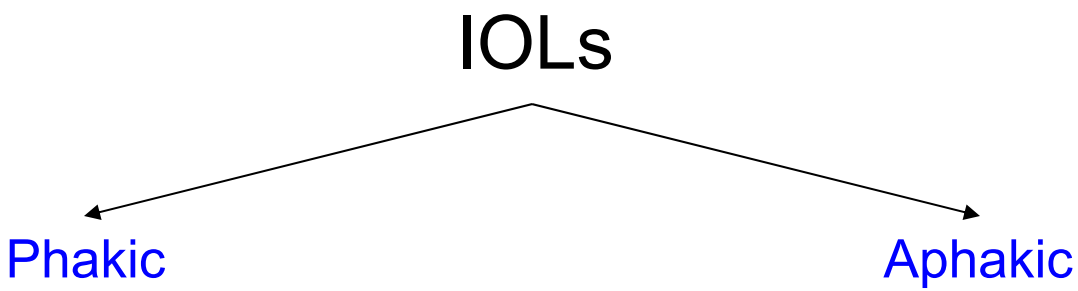


A sulcus-placed IOL with square-edged haptics has chafed the back of the iris, as demonstrated by the transillumination defect in the shape of the haptic



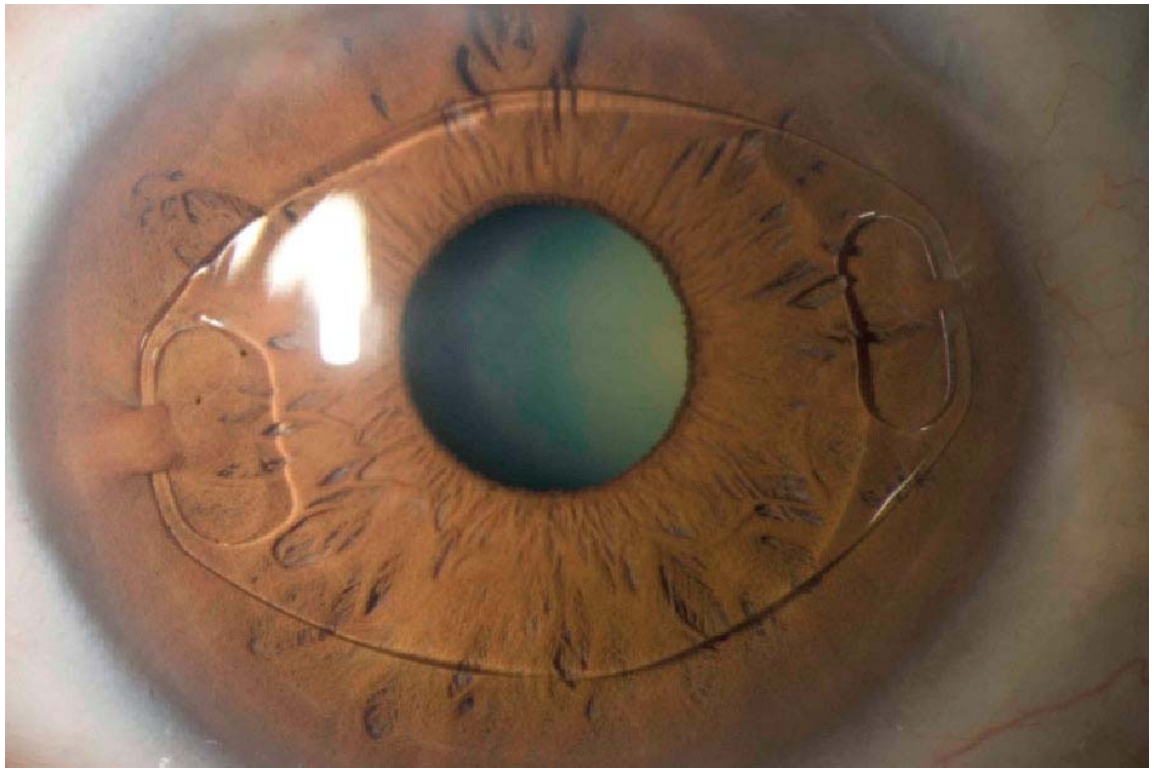
There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Refractive status of eye



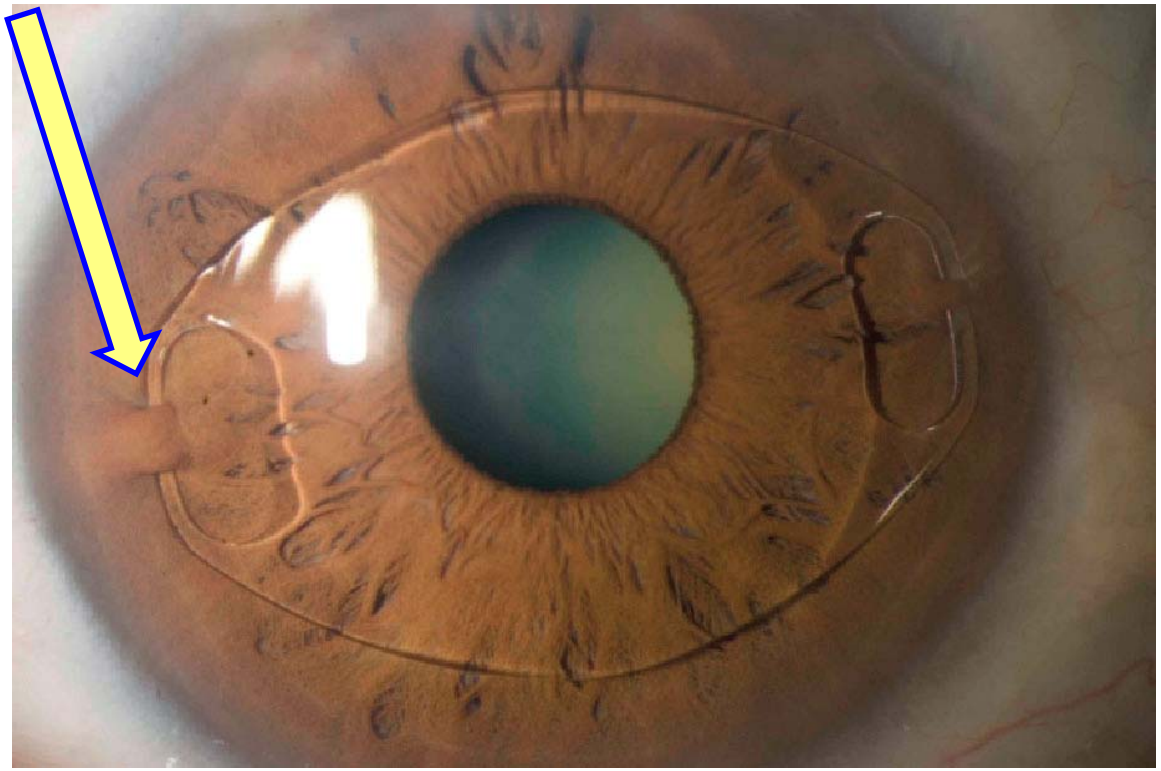
There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Refractive status of eye



Phakic IOL

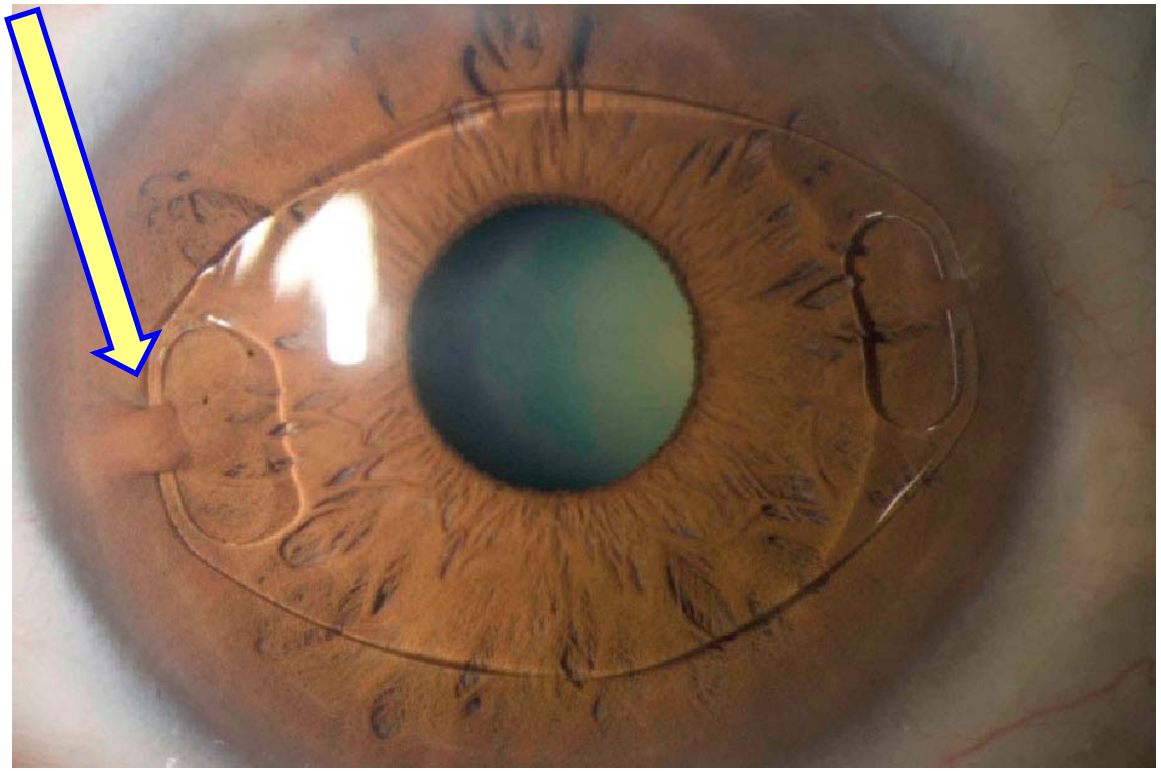
What's the $2 term for the process by which this IOL 'pinches' the iris?



Phakic IOL

What's the $2 term for the process by which this IOL 'pinches' the iris?

'Enclavation'



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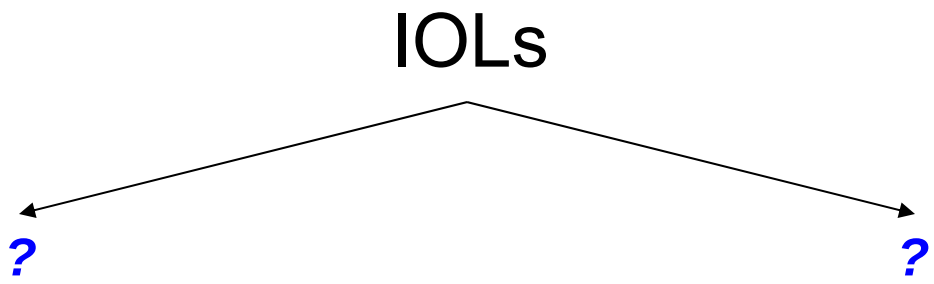
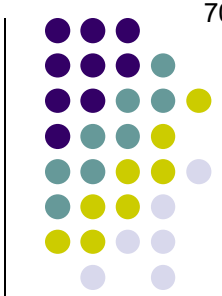
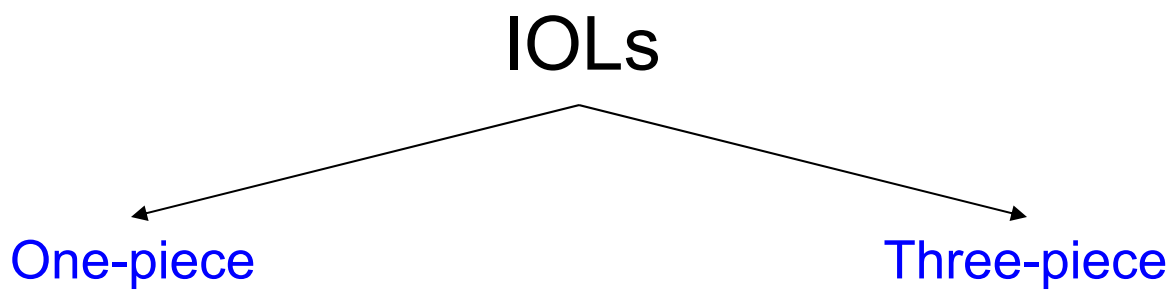


There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Construction



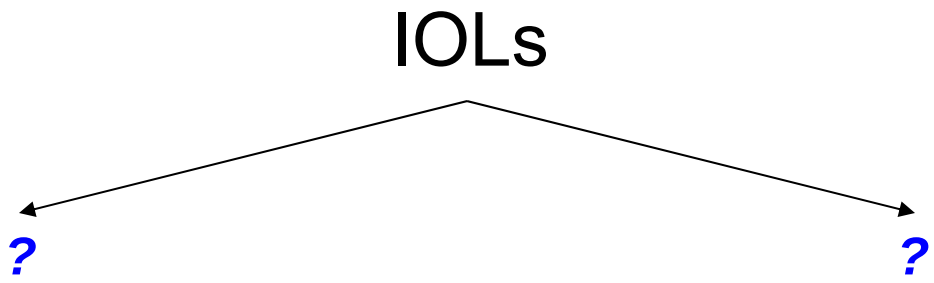


There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Construction

Three-piece IOL

One-piece IOL



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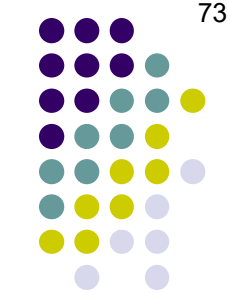
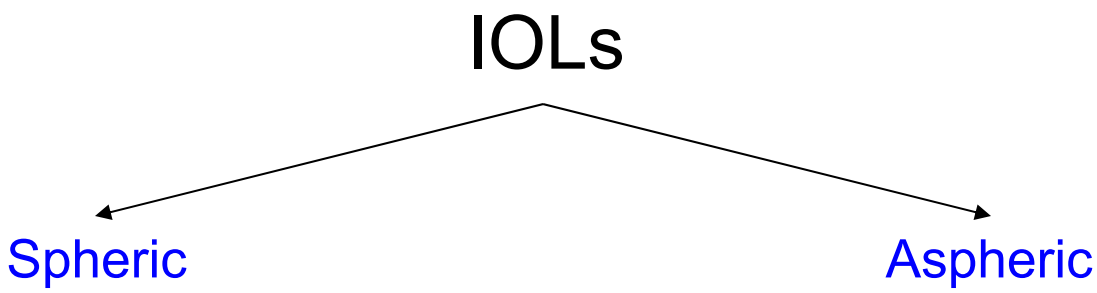
Sphericity





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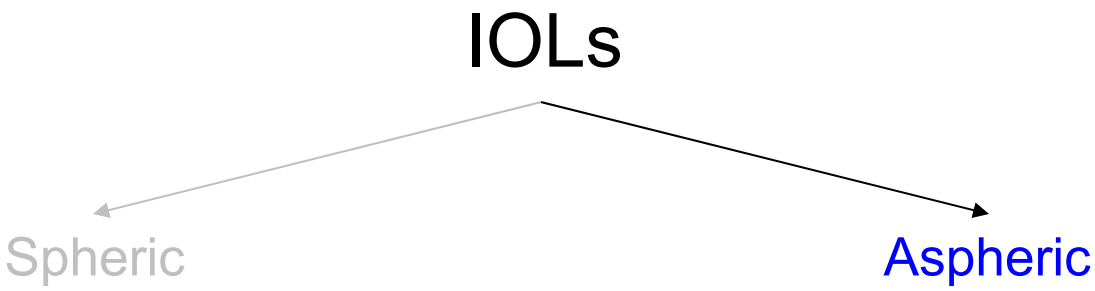
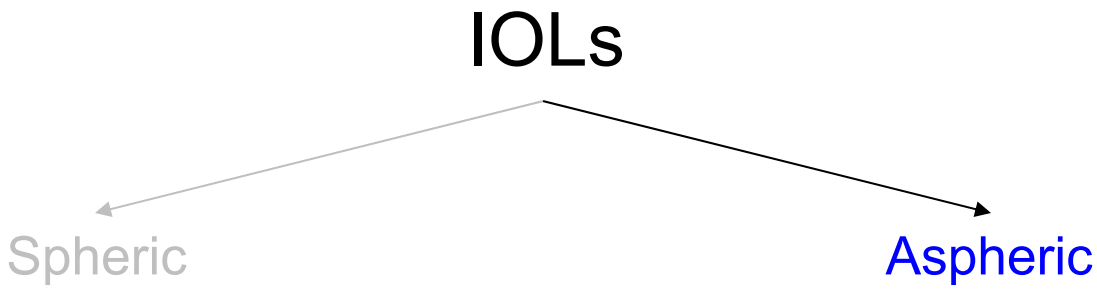
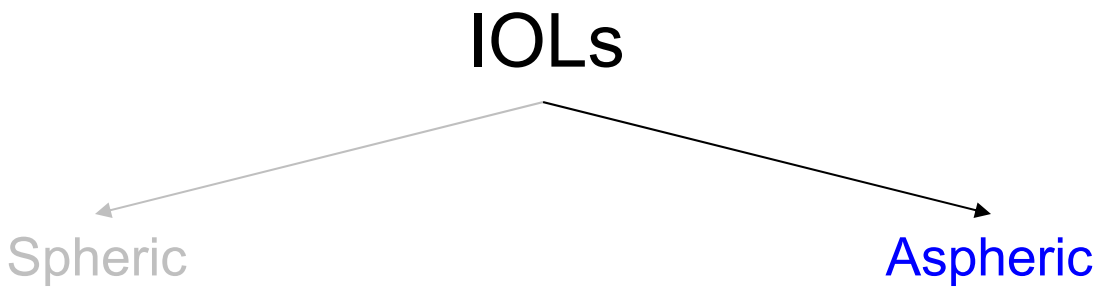


What does it mean to say an IOL is aspheric*?*



What does it mean to say an IOL is aspheric*?*
It simply means the radius of curvature is not constant across its refracting surface(s)



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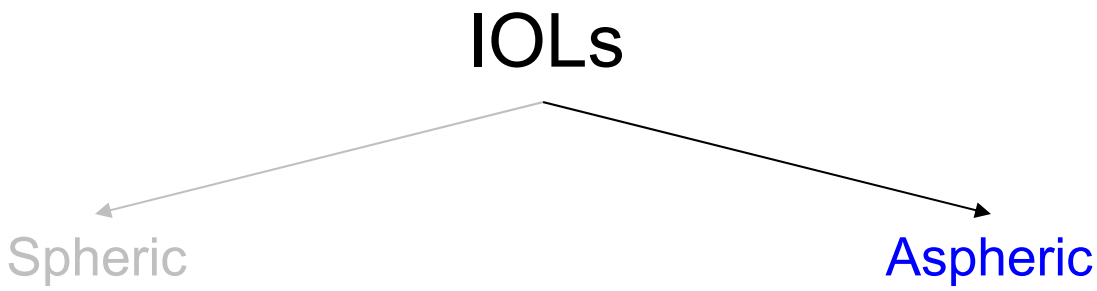
Why might an aspheric design be preferred over a spherical one?



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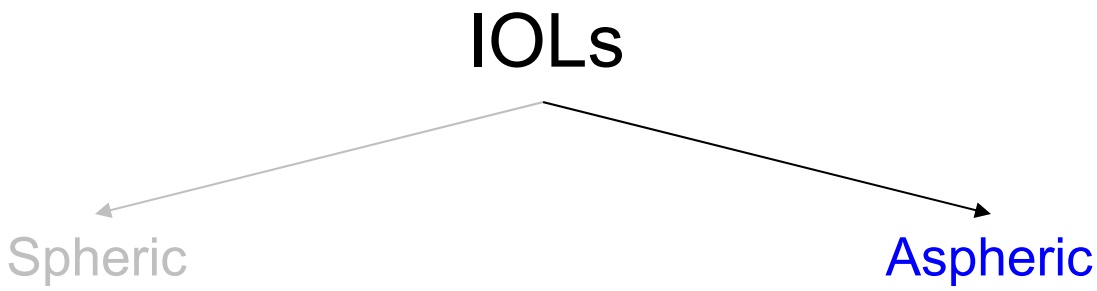
Because it (an aspheric design) might reduce the impact of the higher-order aberration known as *spherical aberration*



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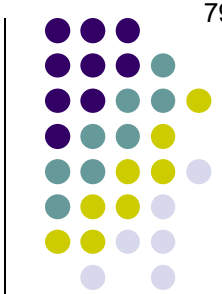
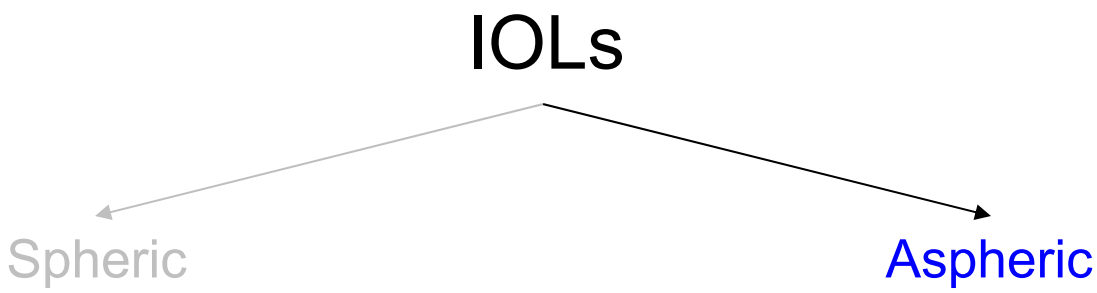
Are aspheric IOLs made with positive *asphericity (= more focusing power peripherally) or* negative *(= less)?*





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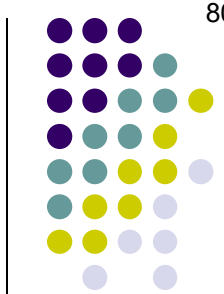
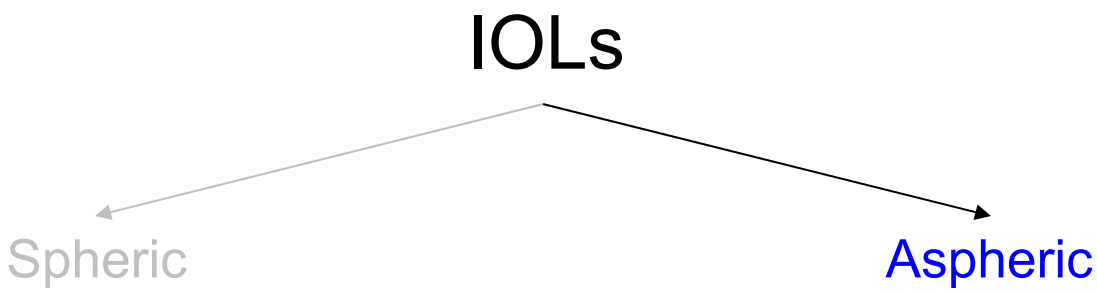
Negative





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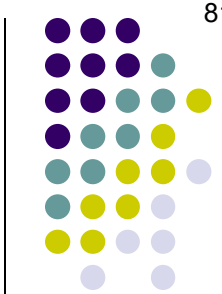
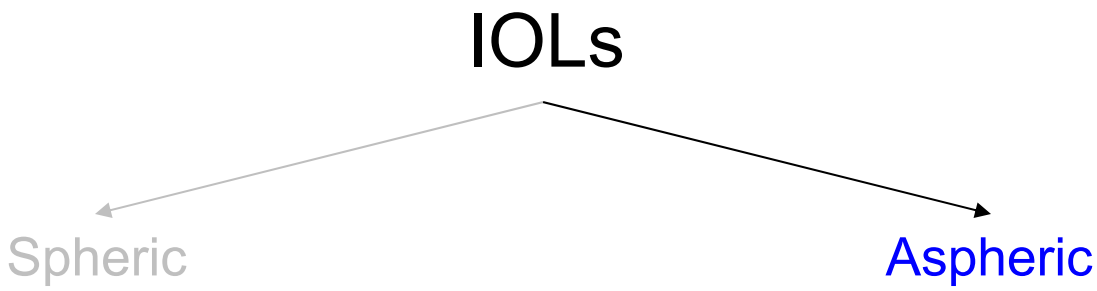
Why negative?





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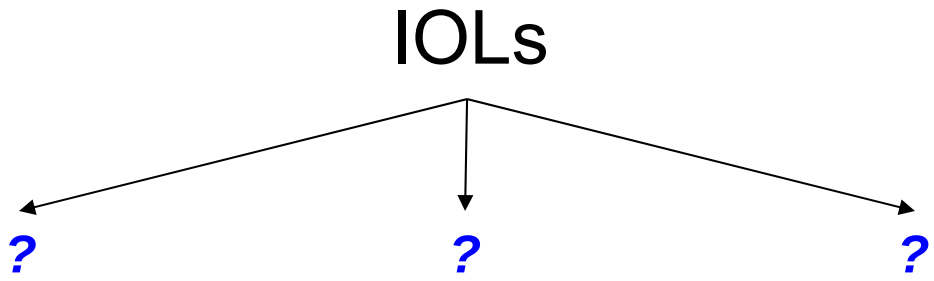
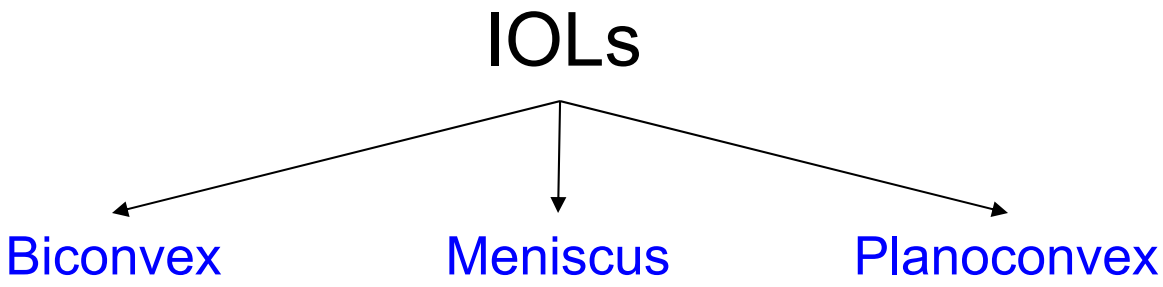
Are aspheric IOLs made with positive *asphericity (= more focusing power peripherally) or* negative *(= less)?*
Negative

Why negative?
To offset the positive asphericity that characterizes most corneas



There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic profile



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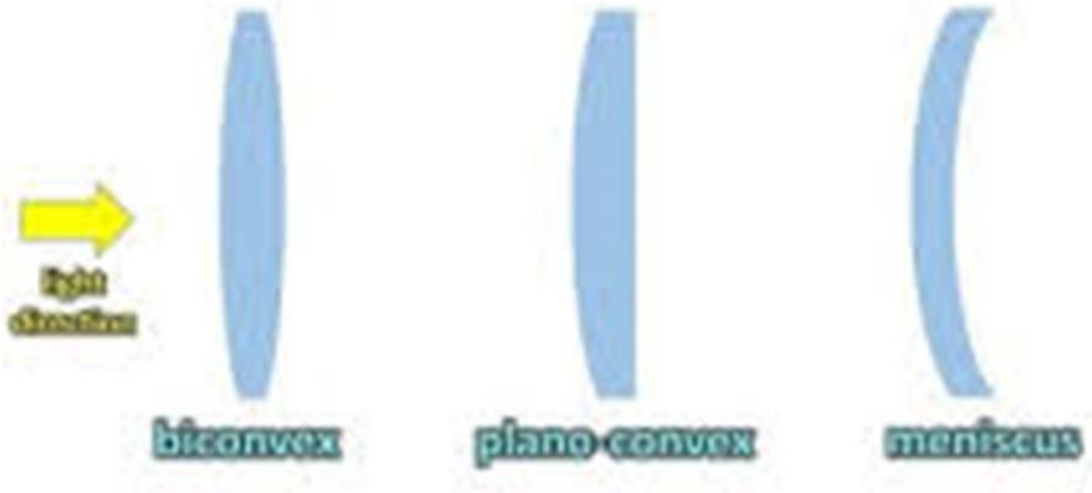
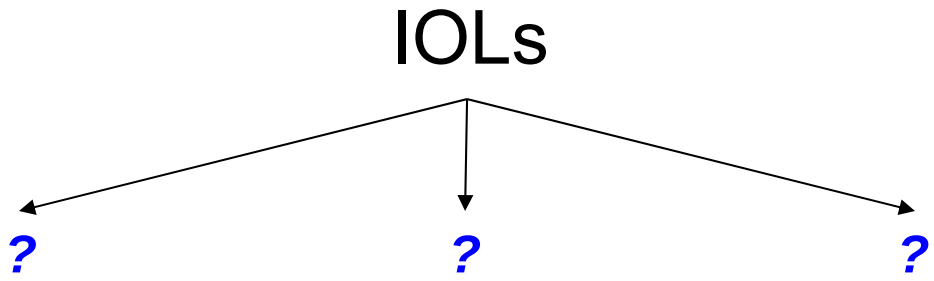
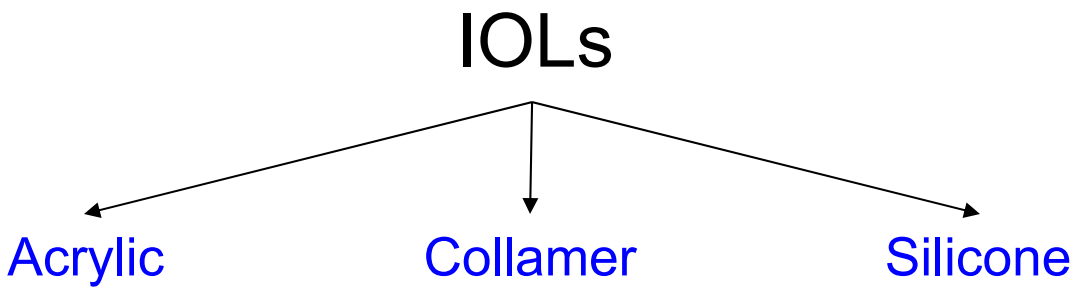


Optics profile



There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic material



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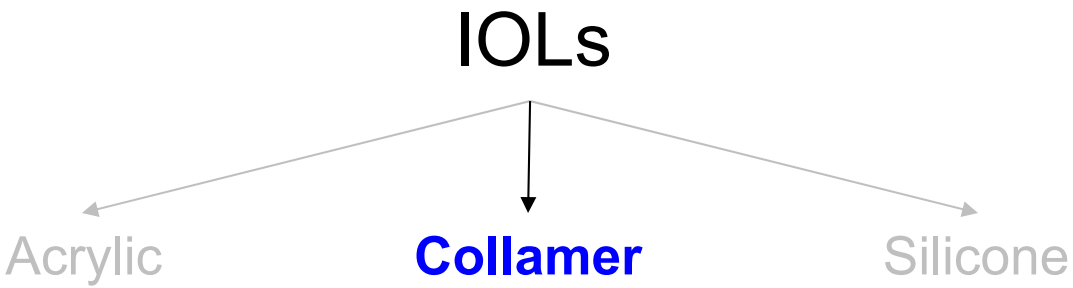

In the US, collamer is typically used for only one particular sort of IOL. What is it?

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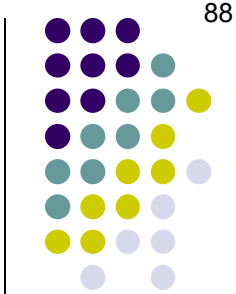
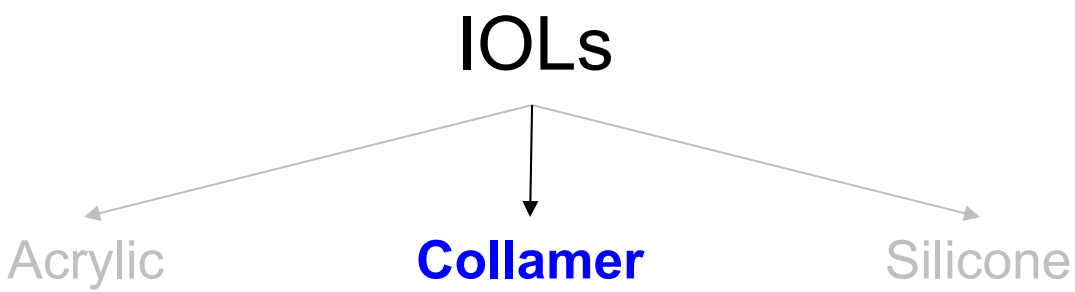
Optic material

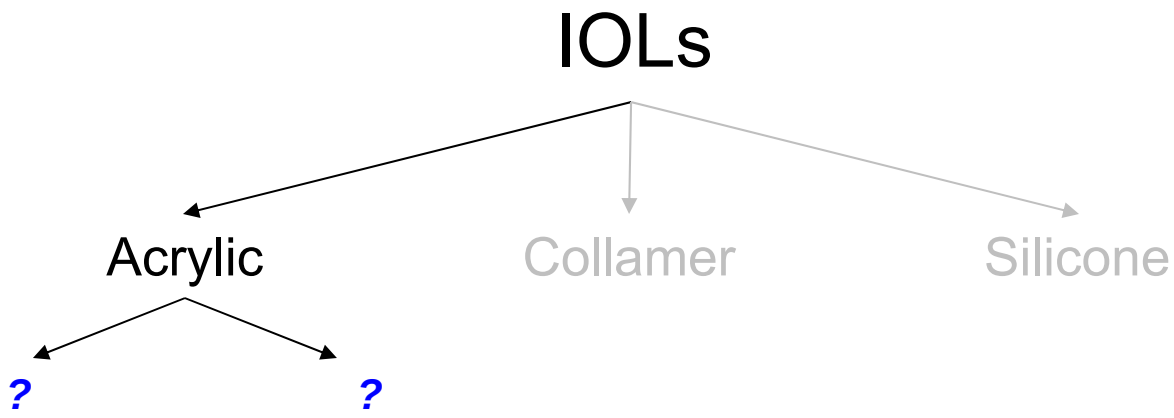




In the US, collamer is typically used for only one particular sort of IOL. What is it?
Phakic posterior-chamber IOLs, *aka* intraocular contact lenses (ICLs)

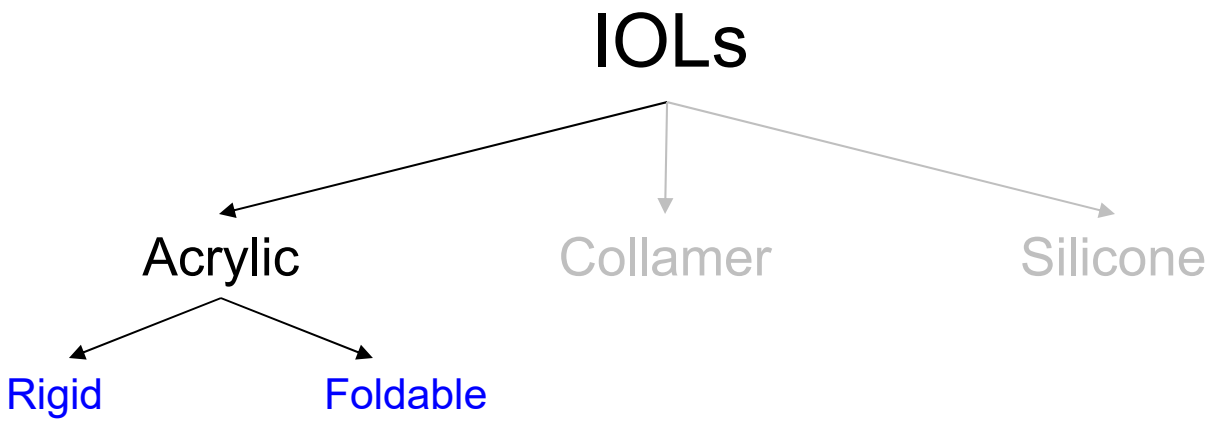
There are any number of ways we can think about/categorize IOLs.
For example, we could divvy them up with respect to:

Optic material



There are any number of ways we can think about/categorize **acrylic IOLs**.
For example, we could divvy them into:

Rigidity



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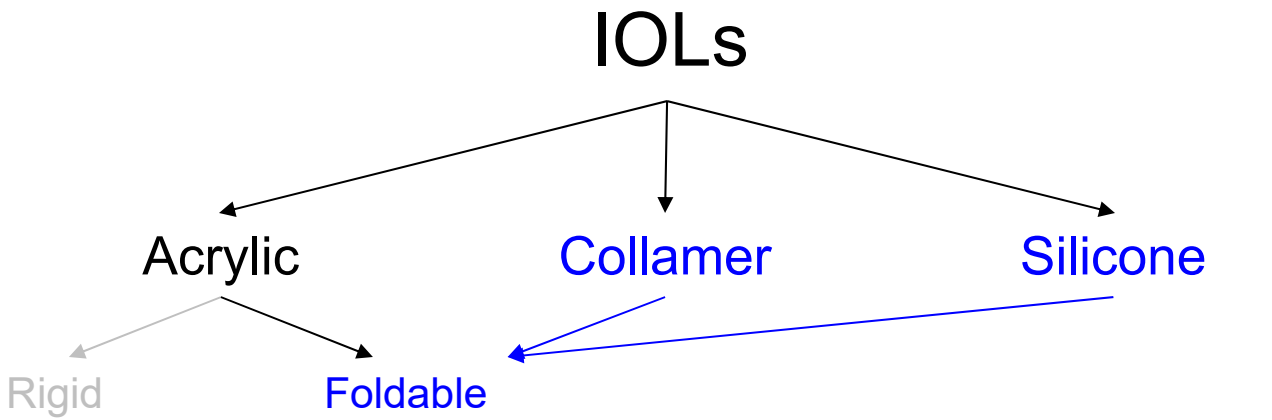
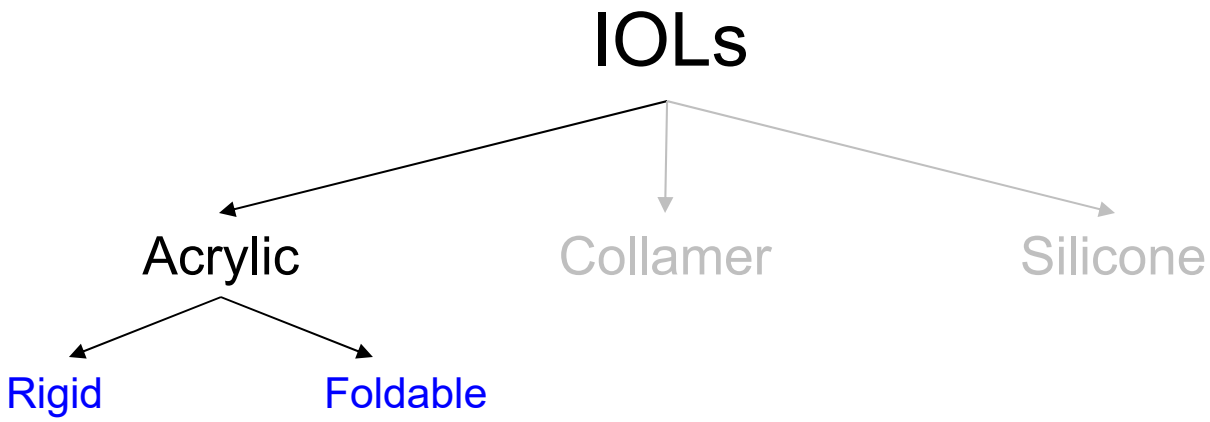


(Collamer and silicone lenses are foldable too)

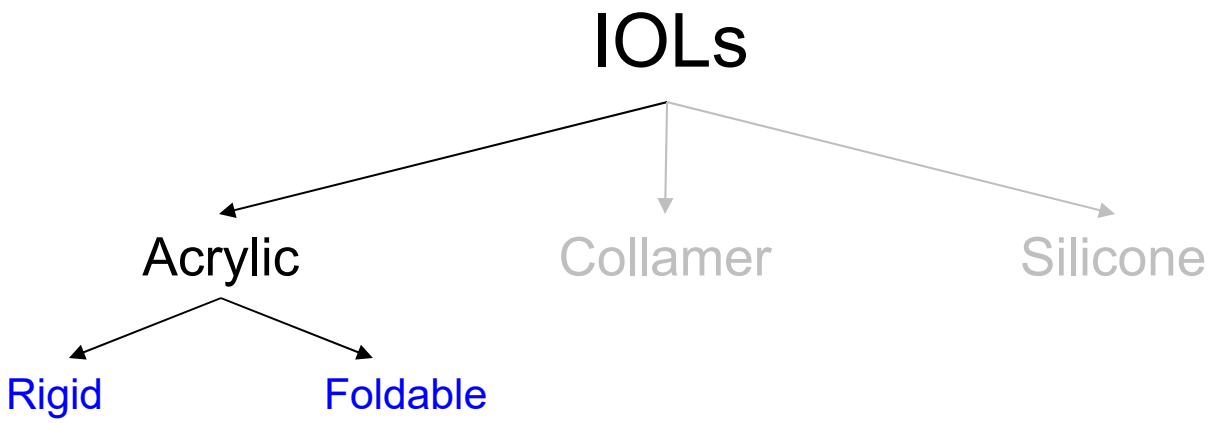
There are any number of ways we can think about/categorize **acrylic IOLs**.
For example, we could divvy them into:

Rigidity



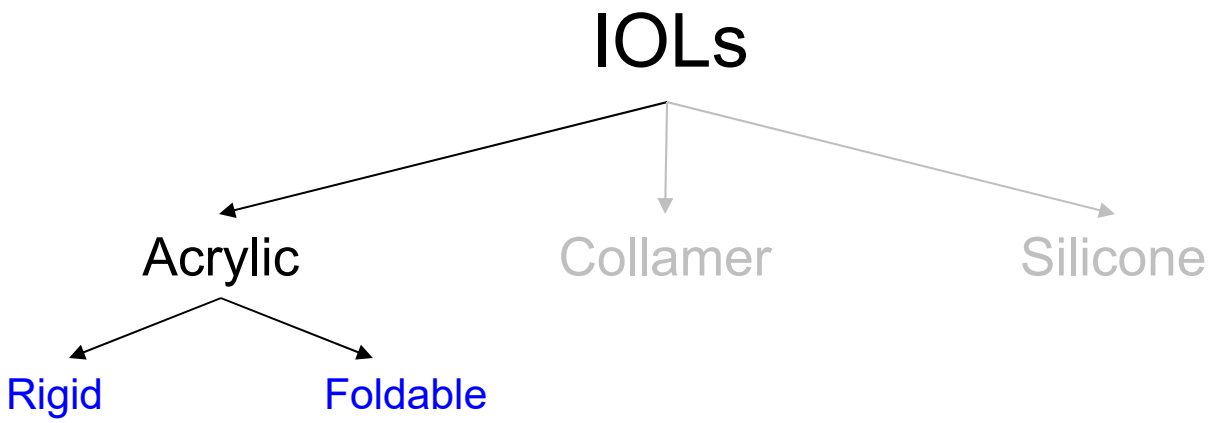
What specific materials are these IOLs made of?
Rigid:
Foldable:

categorize **acrylic IOLs**.
For example, we could divvy them into:
Rigidity



What specific materials are these IOLs made of?
Rigid: PMMA, which is the acronym for poly(methyl methacrylate)
Foldable: Various acrylic polymers (more about this on the next slide)

categorize **acrylic IOLs**.
For example, we could divvy them into:
Rigidity



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Which sort of acrylic IOL dominates the market?

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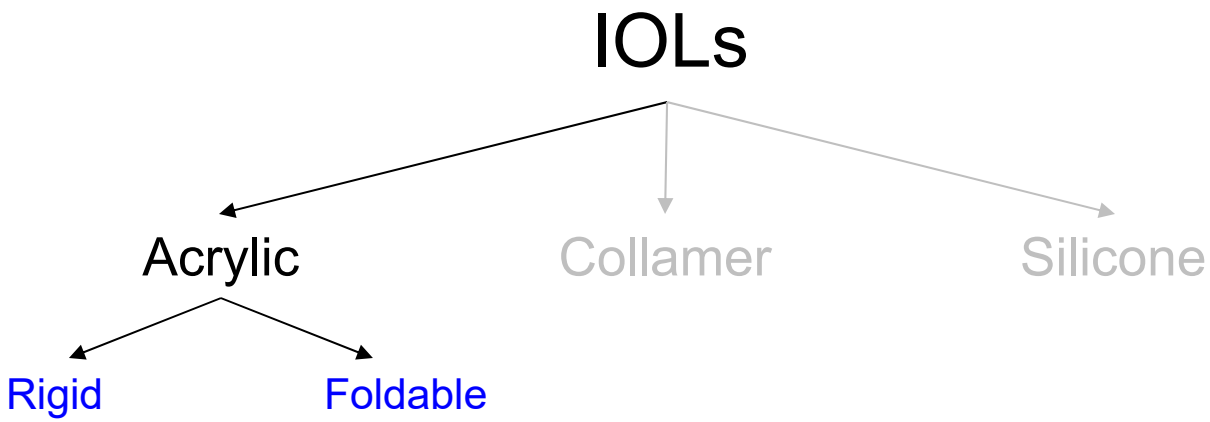
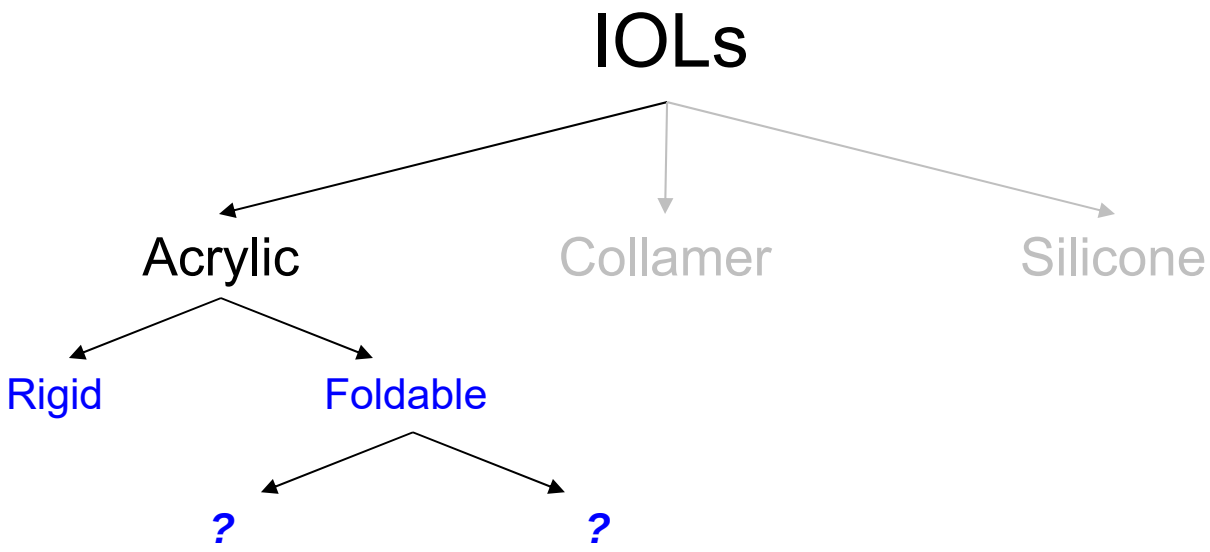


What specific materials are these IOLs made of?
Rigid: PMMA, which is the acronym for poly(methyl methacrylate)
Foldable: Various acrylic polymers (more about this on the next slide)

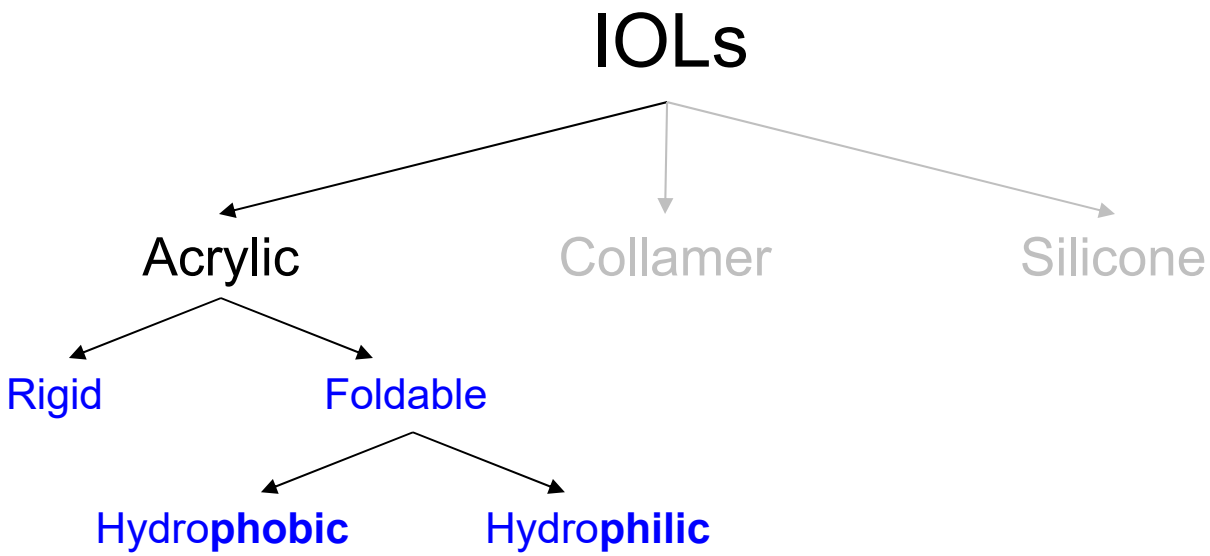
Which sort of acrylic IOL dominates the market?
Foldable (rigid materials are essentially only used for AC IOLs)

categorize **acrylic IOLs**.
For example, we could divvy them into:
Rigidity



There are any number of ways we can think about/categorize ***foldable*** **acrylic IOLs**.
For example, we could divvy them into:

Water status



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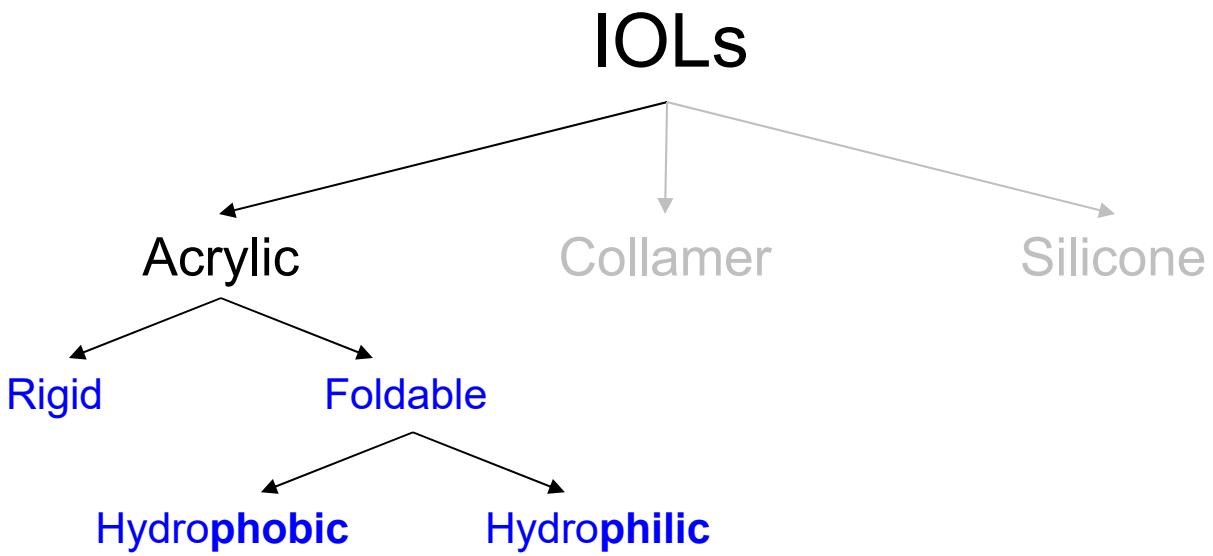

In short, what is the chief difference between the hydrophobic and -philic materials?

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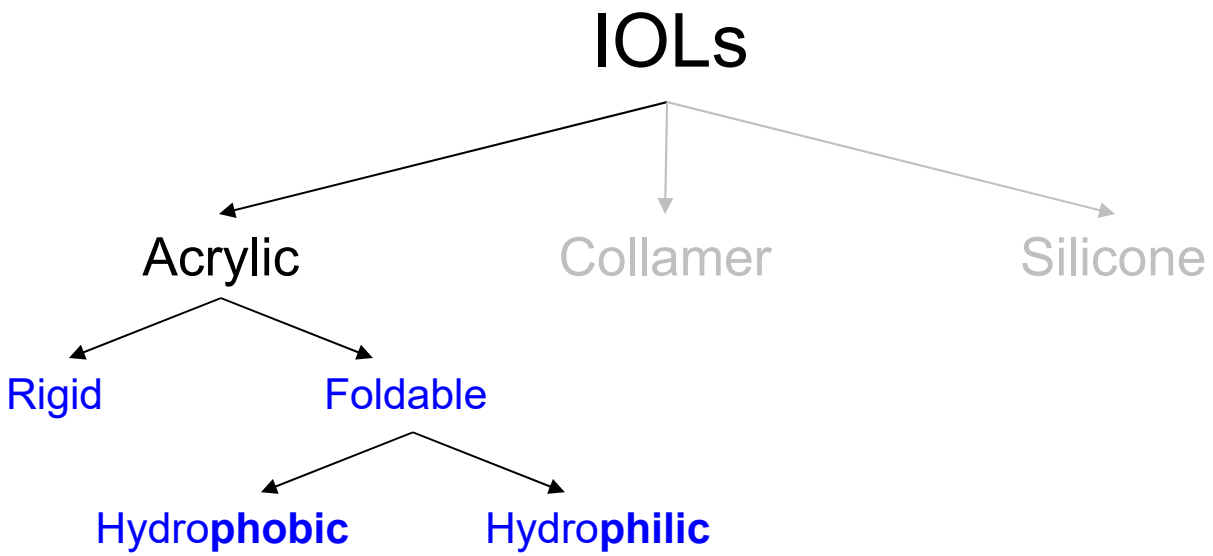

In short, what is the chief difference between the hydrophobic and -philic materials?
The amount of water they incorporate (not surprisingly, the -phobic IOLs contain far less)

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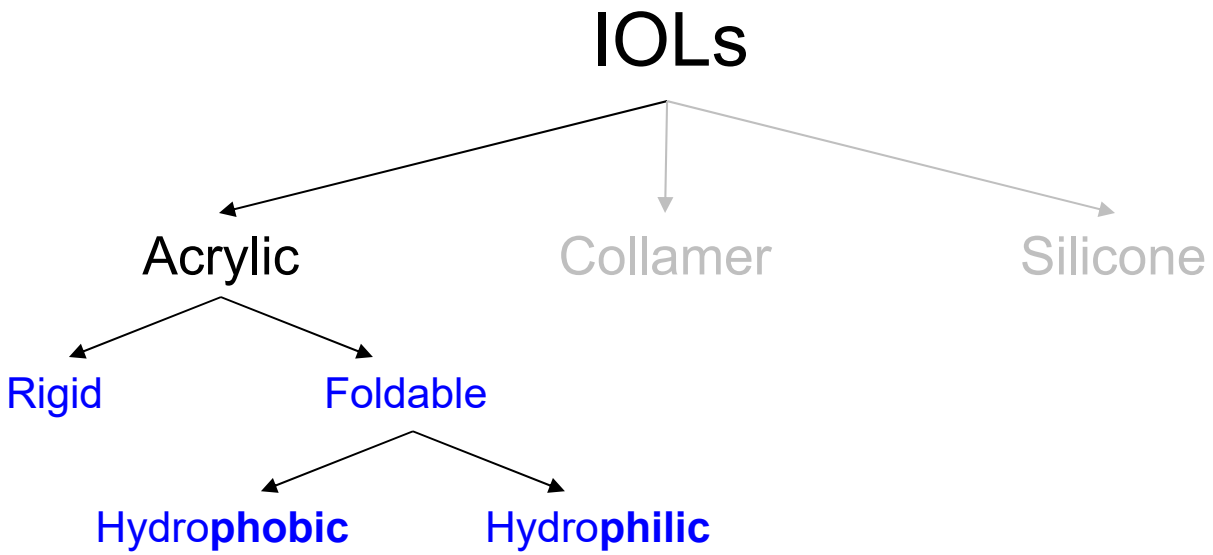

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What is considered the chief advantage of each?
Hydrophobic:
Hydrophilic:

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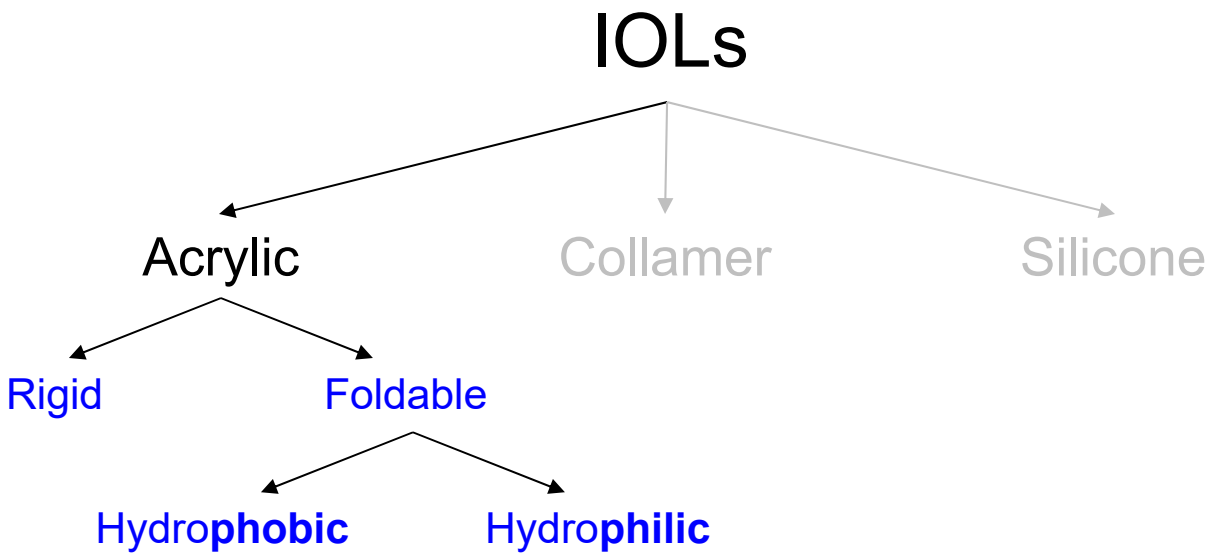

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Hydrophobic: Less likely to develop
Hydrophilic: Less likely to develop

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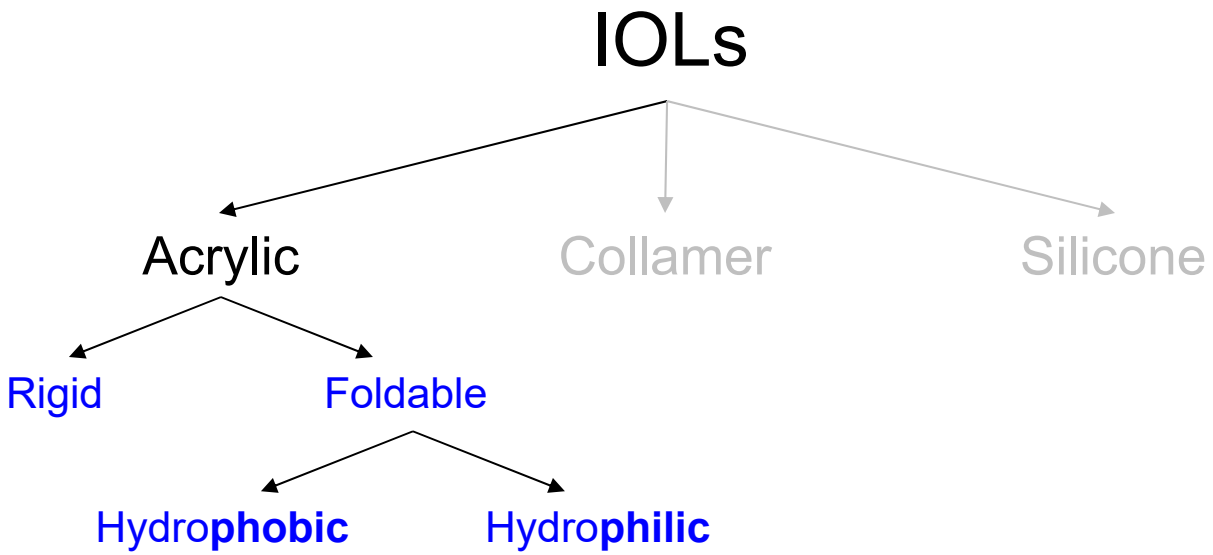

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Hydrophilic: Less likely to develop glistenings

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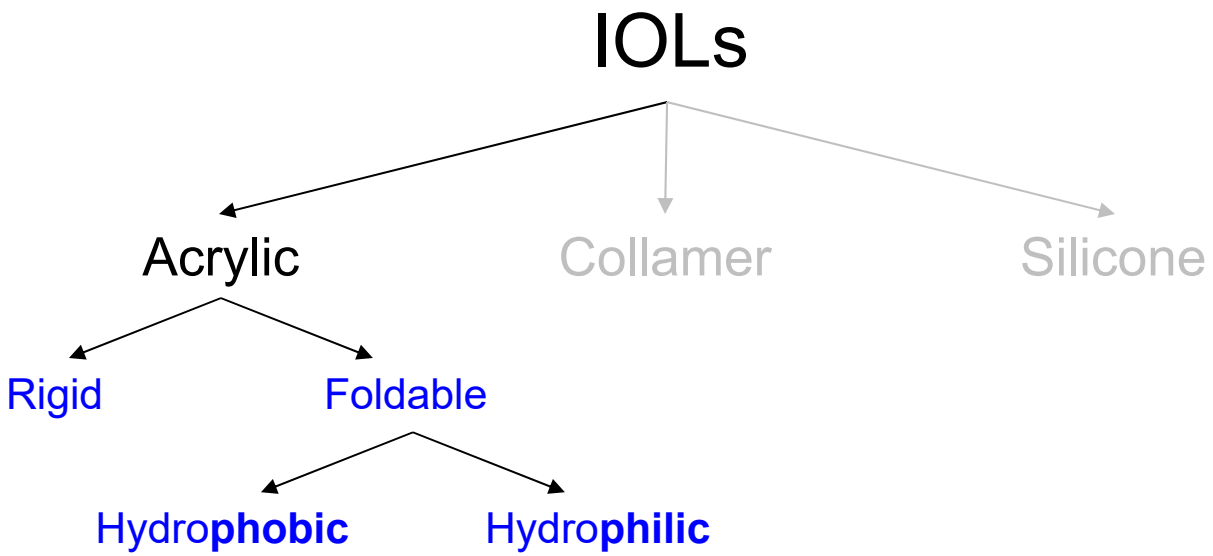

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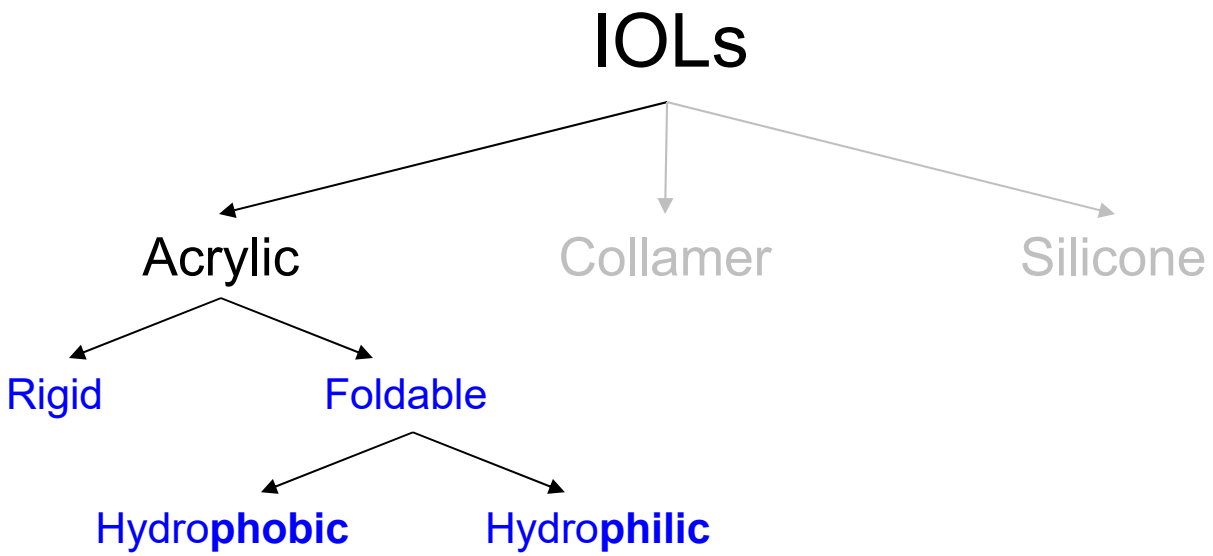
What are glistenings*?*

LS.



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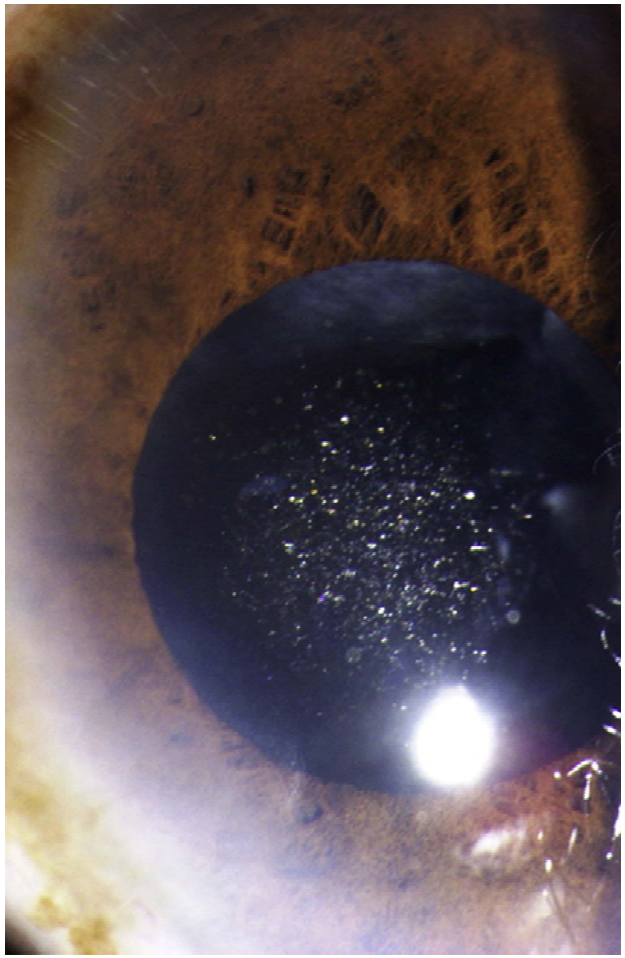
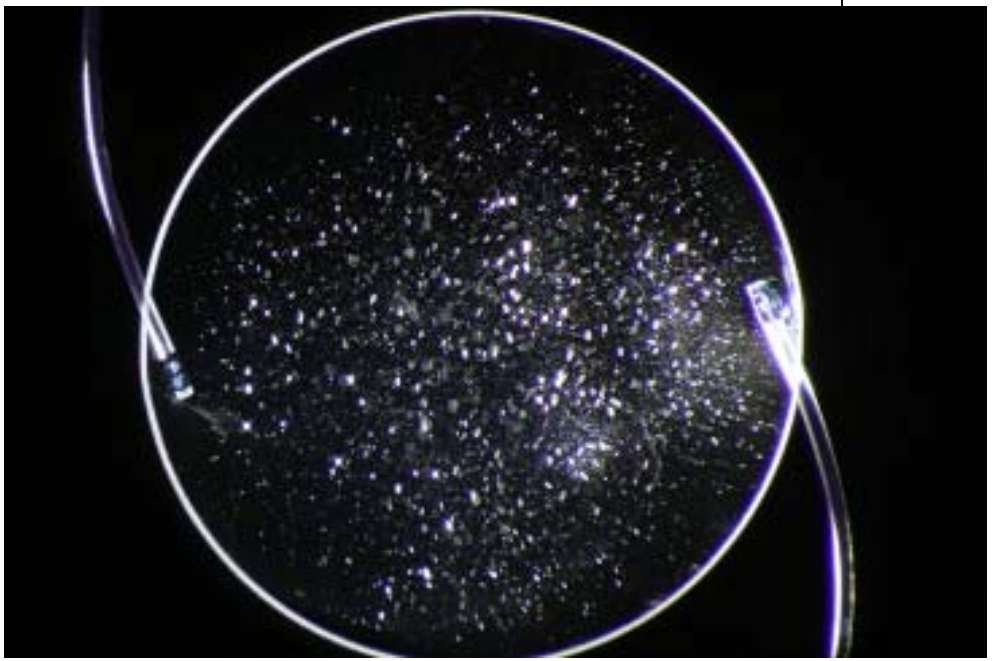
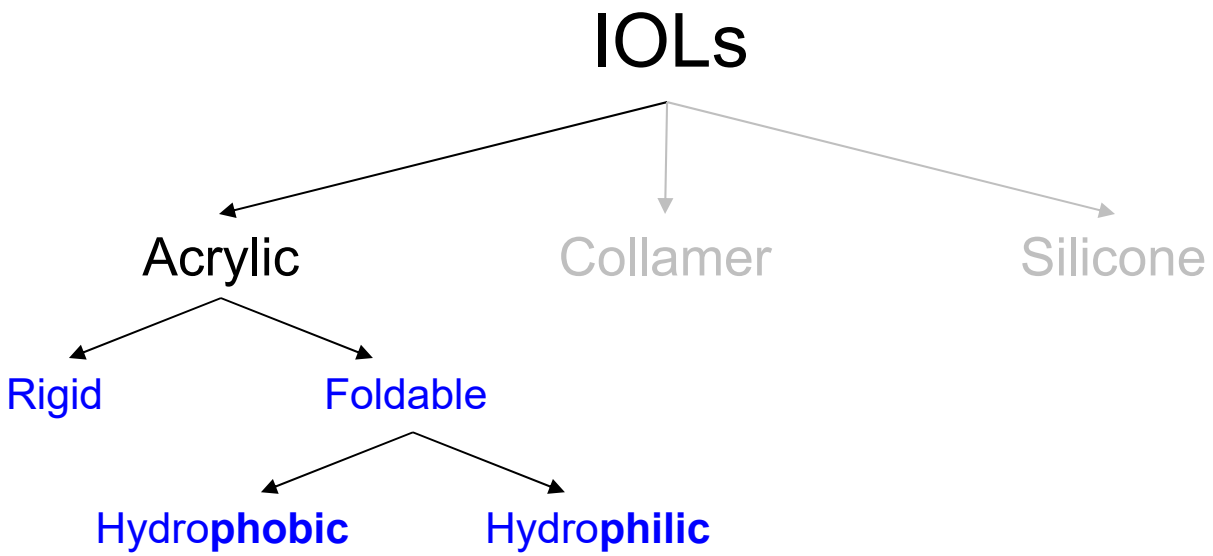
What are glistenings*?*
Glistenings are tiny fluid-filled vacuoles on the surface of the IOL

LS.





Glistenings



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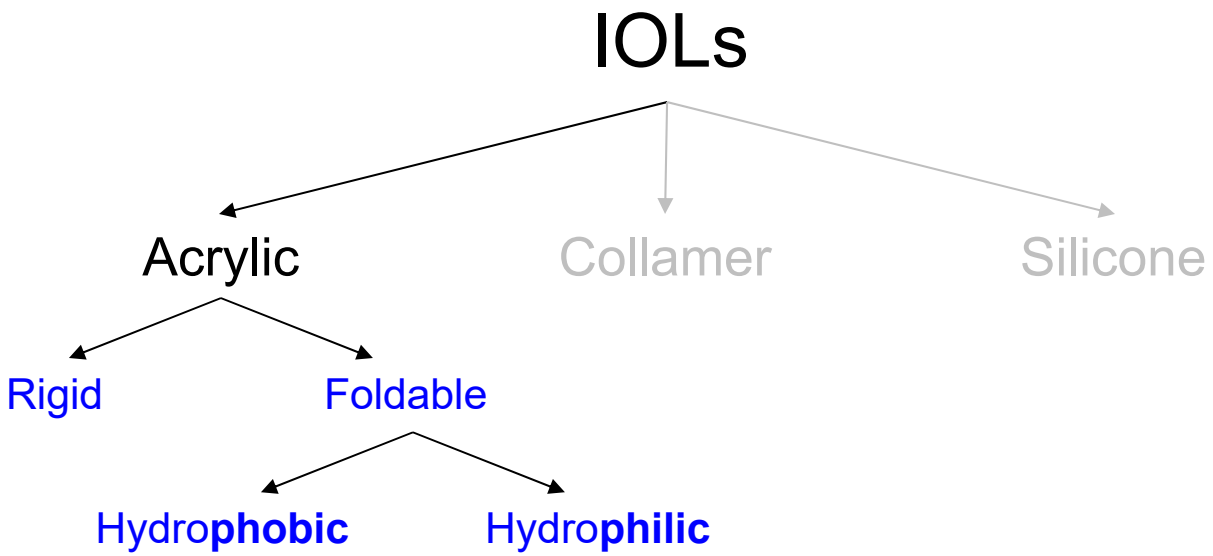

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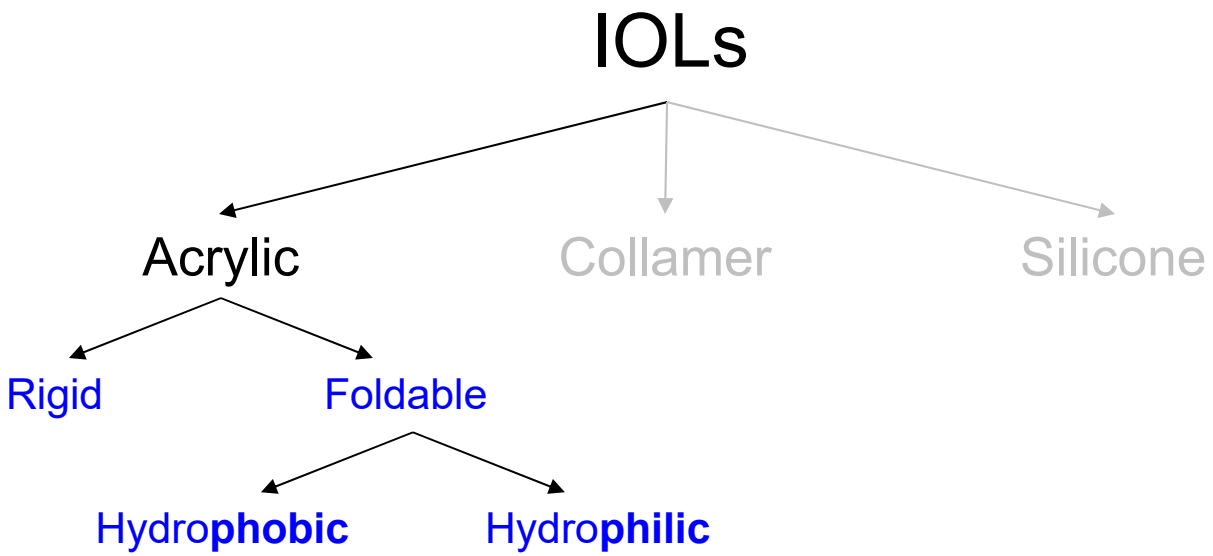

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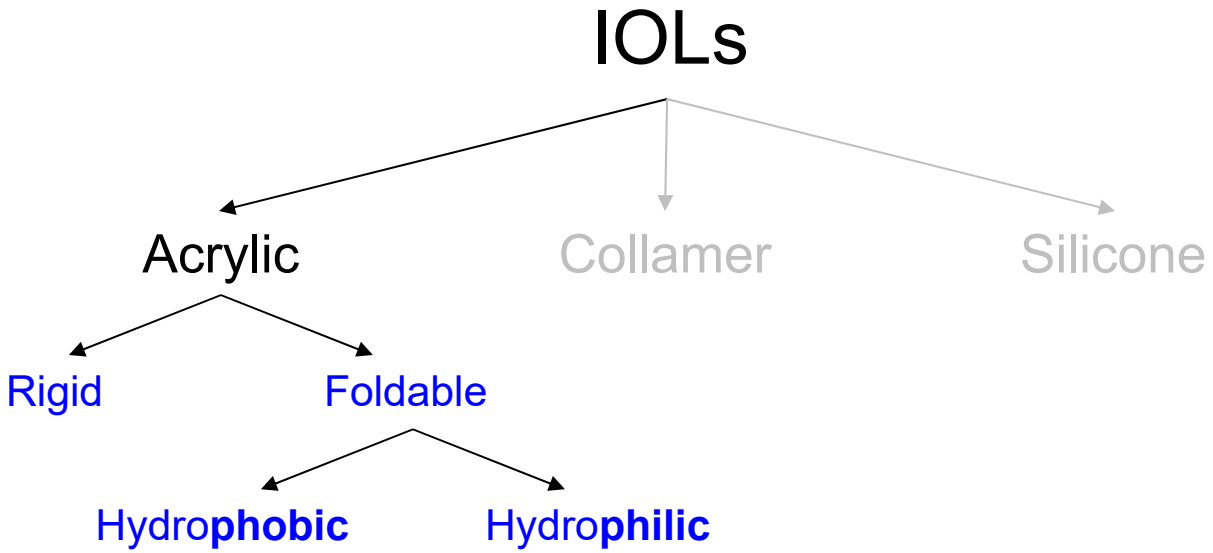

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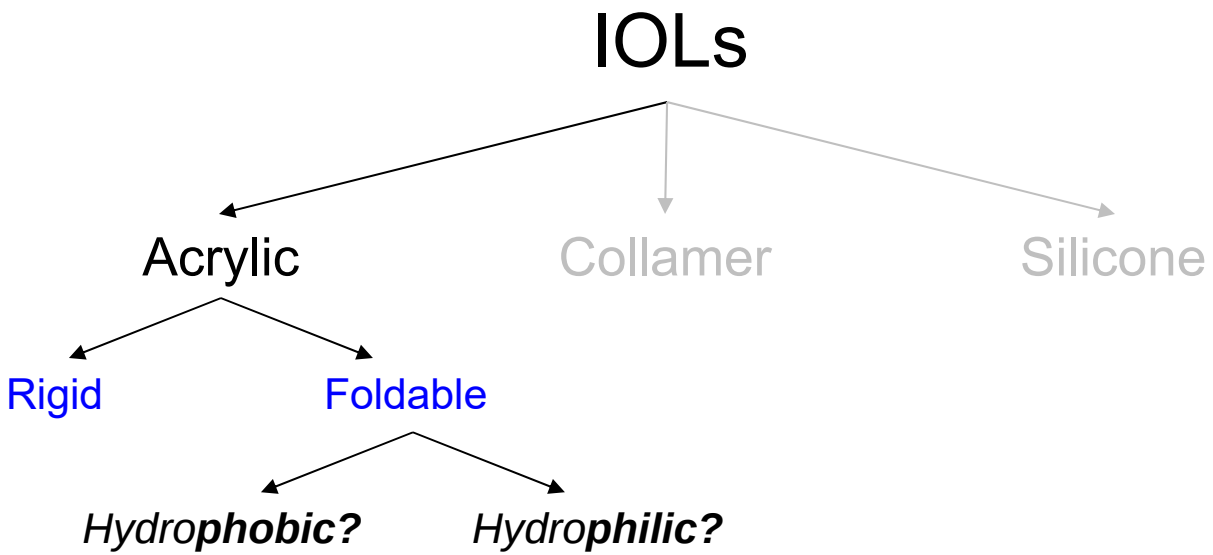
Glistenings have been reported with virtually all IOL materials, but are vastly more likely to occur in acrylic



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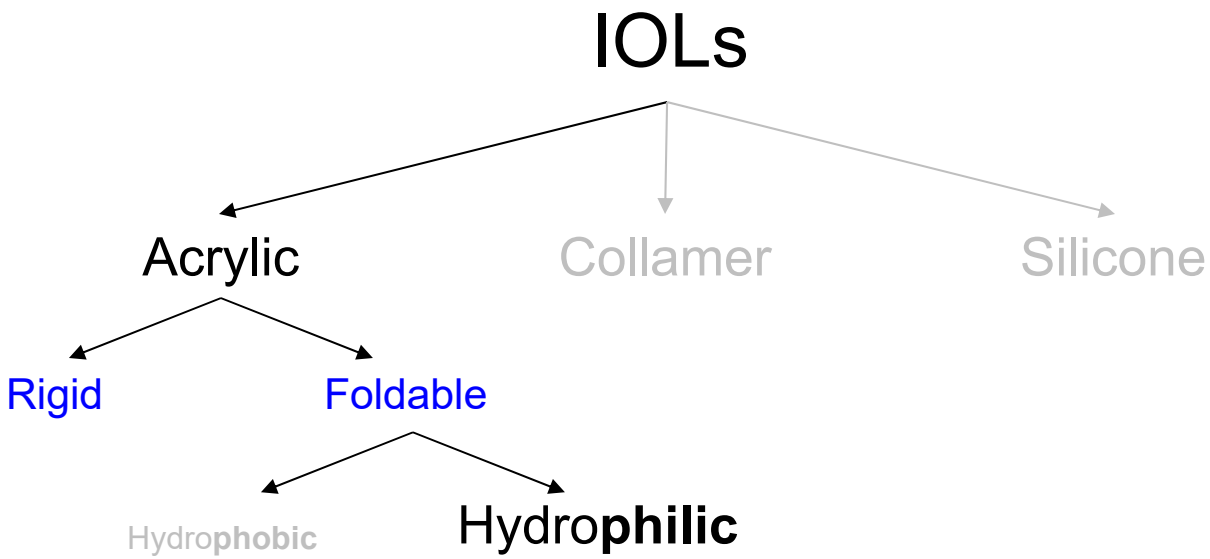

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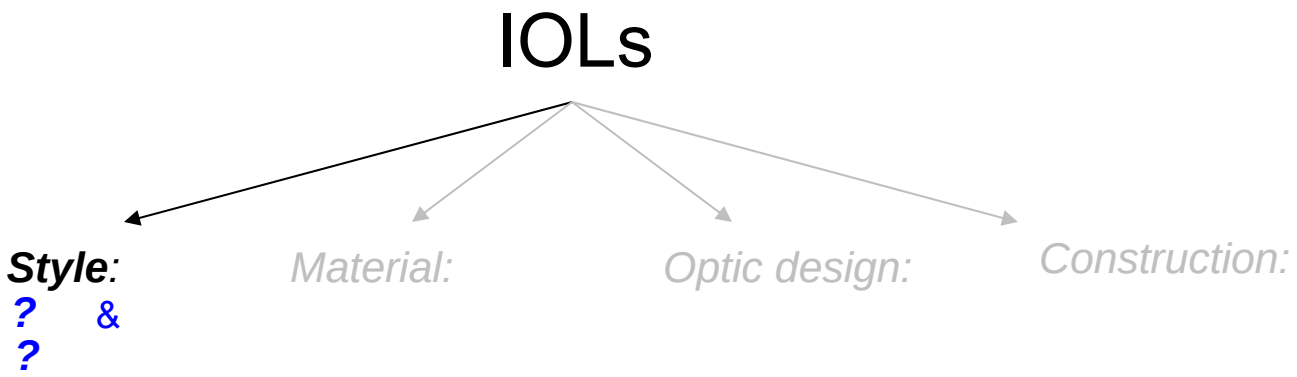
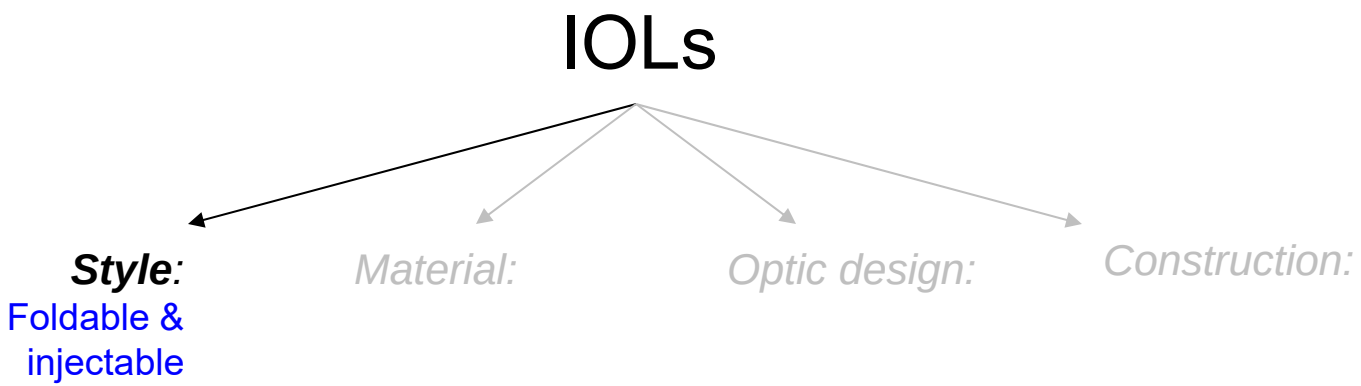


Putting it all together: Modern in-the-bag IOLs typically share the above characteristics:



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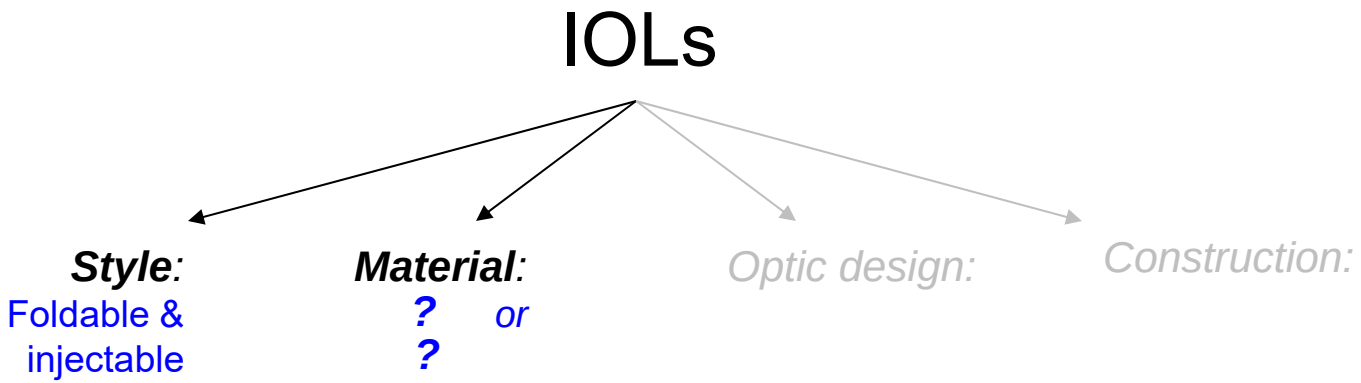

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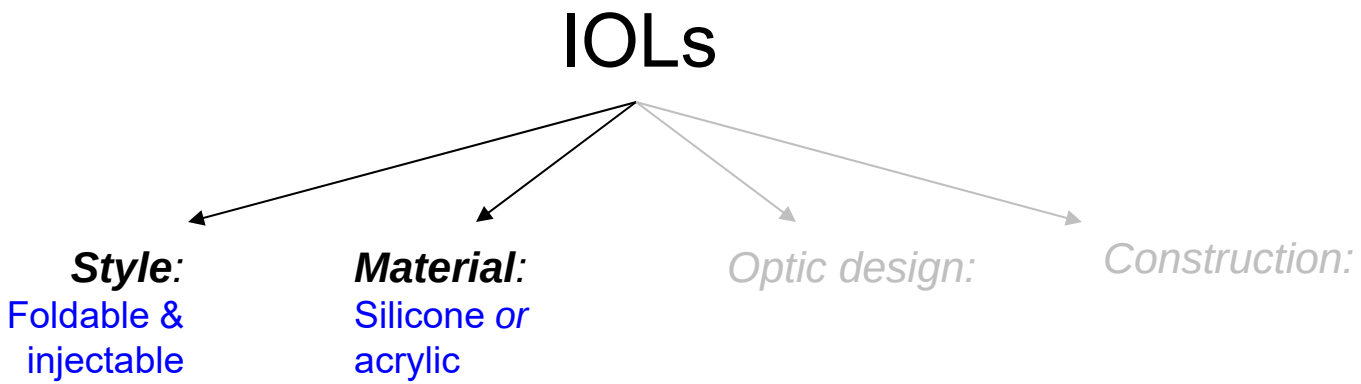

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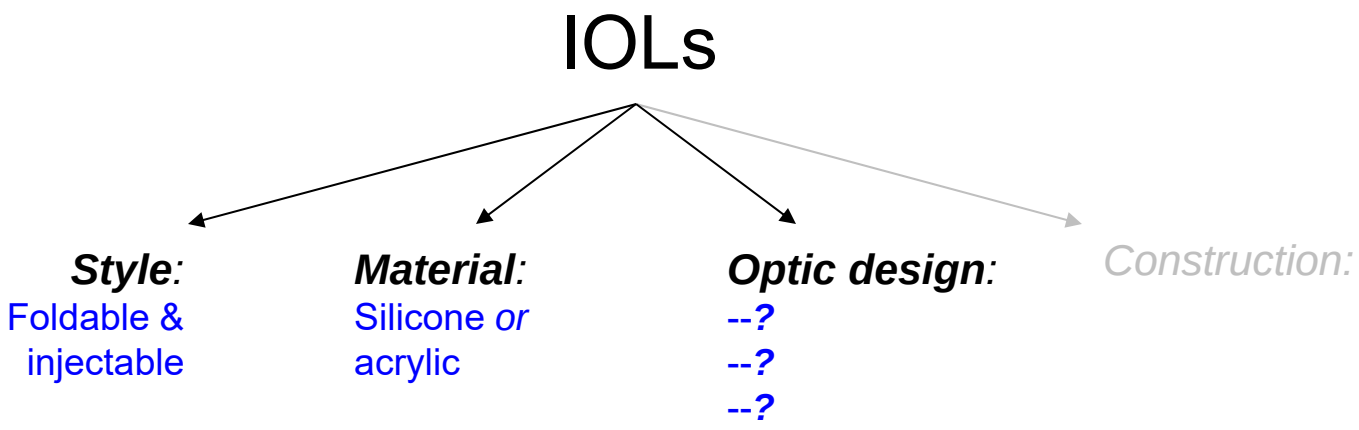

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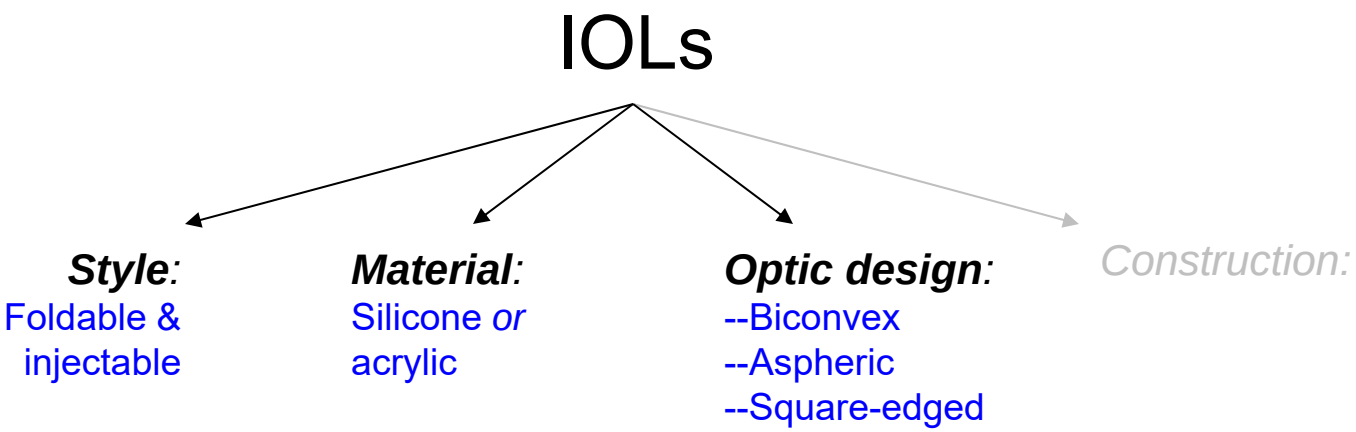

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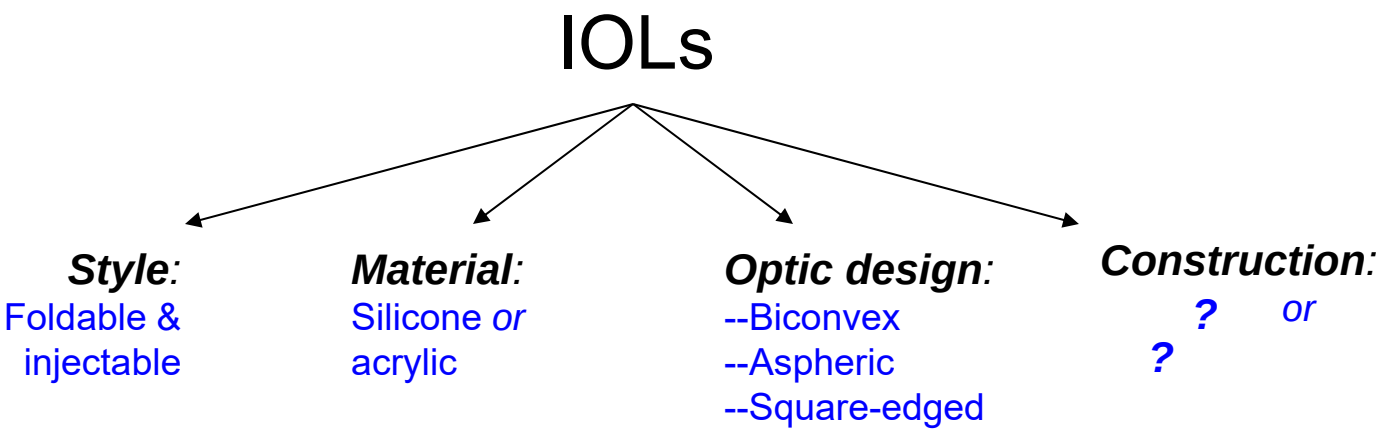

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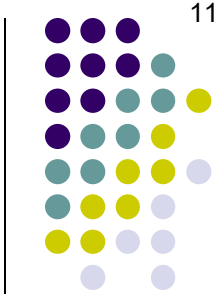

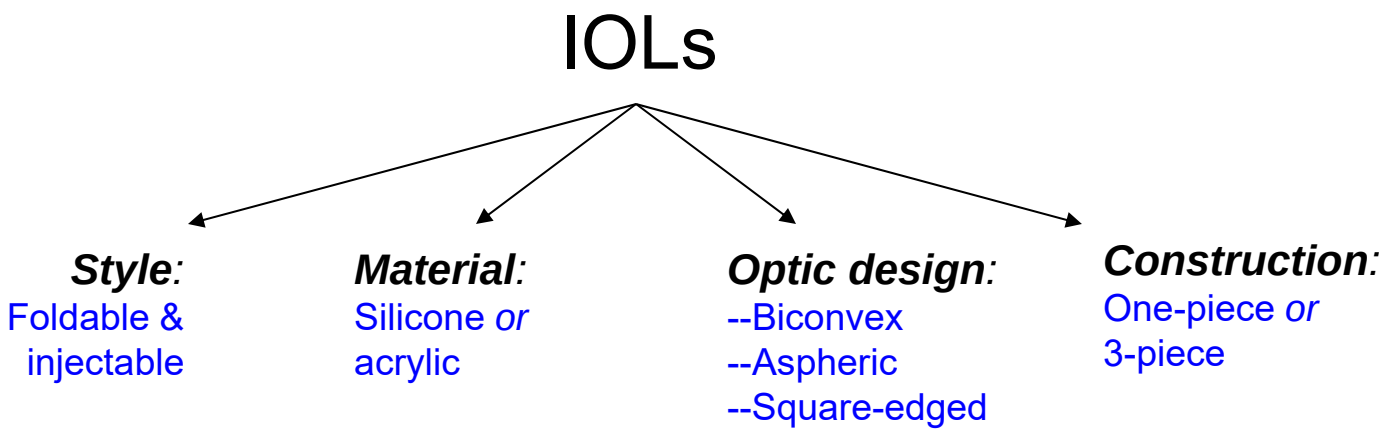

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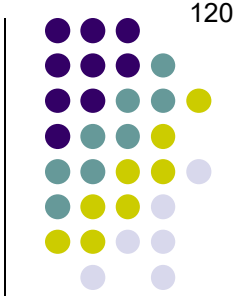

Presbyopia-correcting IOLs

Next let's talk about ***presbyopia-correcting IOLs***. But first:

What is Presbyopia*?*

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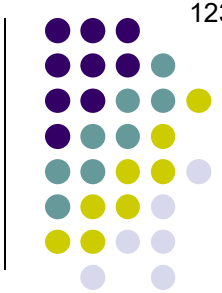
The gradual, age-related loss of accommodative capacity



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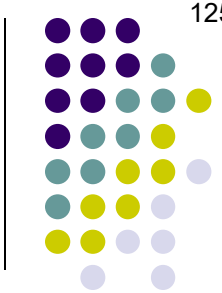
What is the cause?
A loss of lens elasticity



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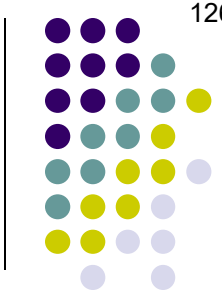

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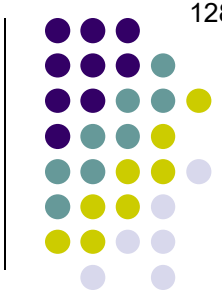

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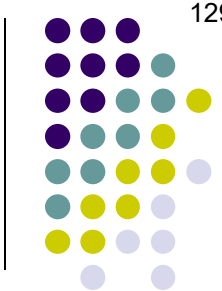

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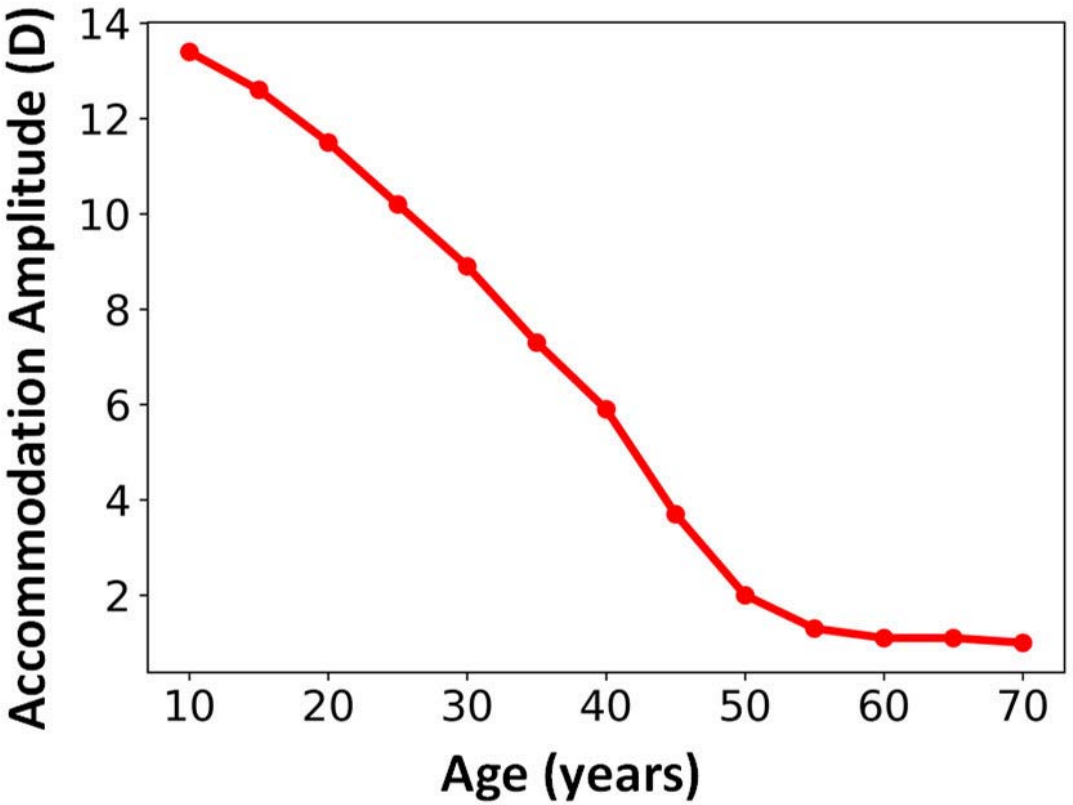
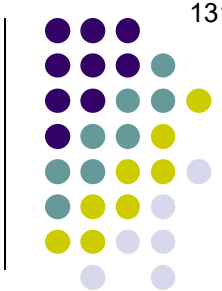


The relationship between age and accommodative amplitude. Adapted from Duane (1922)



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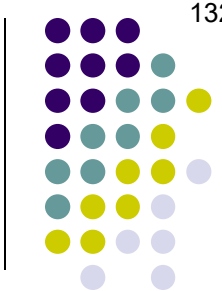

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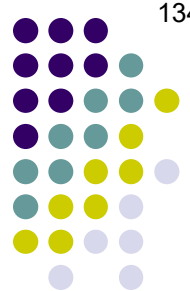
Can Presbyopia *be corrected with standard IOLs?*



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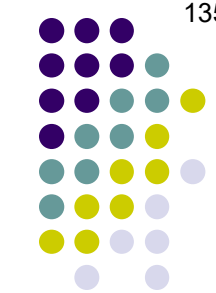

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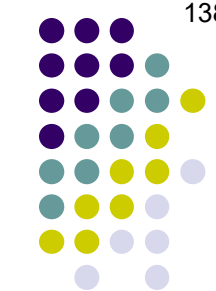

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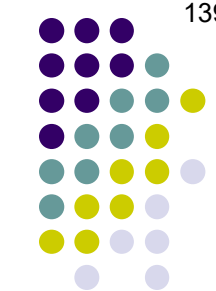

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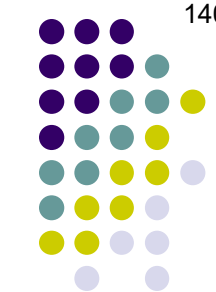

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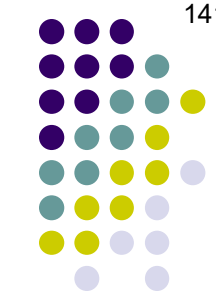

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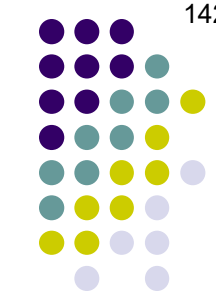

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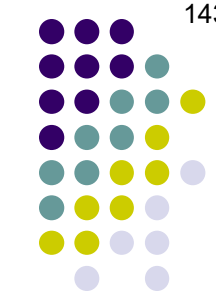

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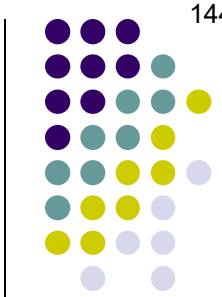
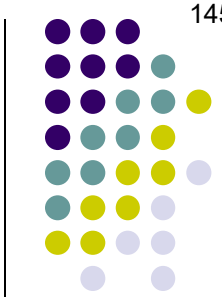
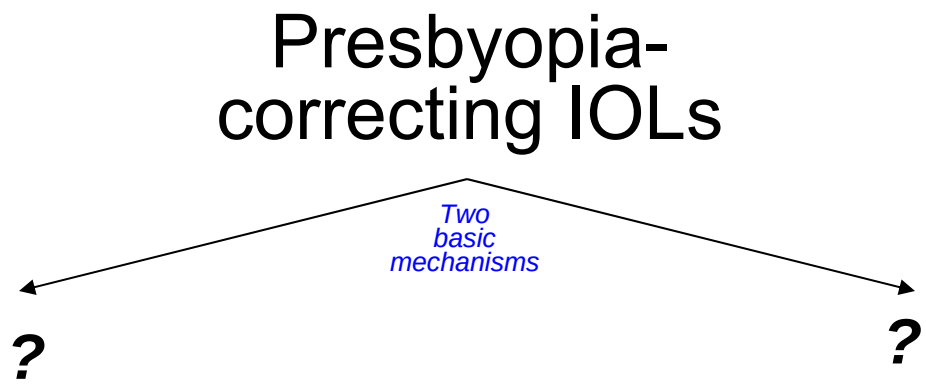


At last—what is a Presbyopia-correcting IOL *?*

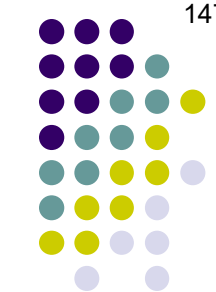


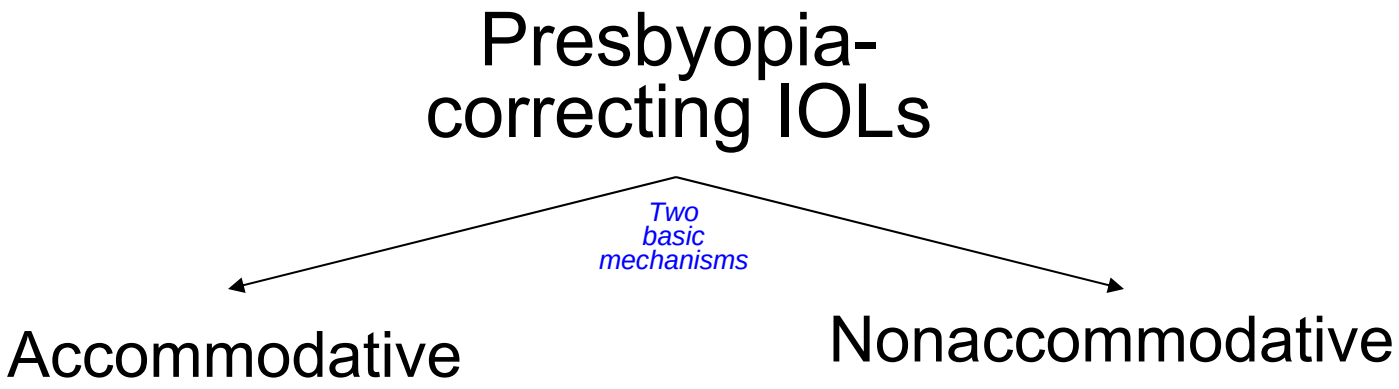
At last—what is a Presbyopia-correcting IOL *?*

An IOL designed to provide good vision at both distance and near (and perhaps other distances as well)



For *presbyopia-correcting IOLs*, we usually divvy them up thusly:





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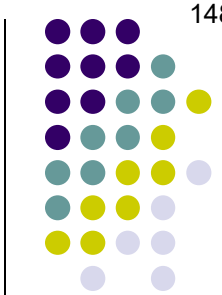
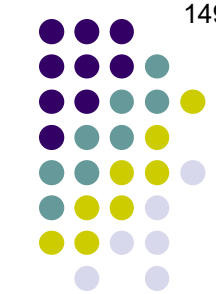


Presbyopia-correcting IOLs

- Accommodative
- Nonaccommodative

What is the difference between an accommodative *IOL and a n*onaccommodative *IOL?*

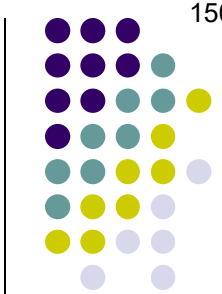


Presbyopia-correcting IOLs

Accommodative

Nonaccommodative

What is the difference between an accommodative *IOL and a n*onaccommodative *IOL?*
To focus at near, an **accommodative** IOL undergoes a conformational change in response to contraction of the ciliary body; ie, it changes focal points by changing shape.

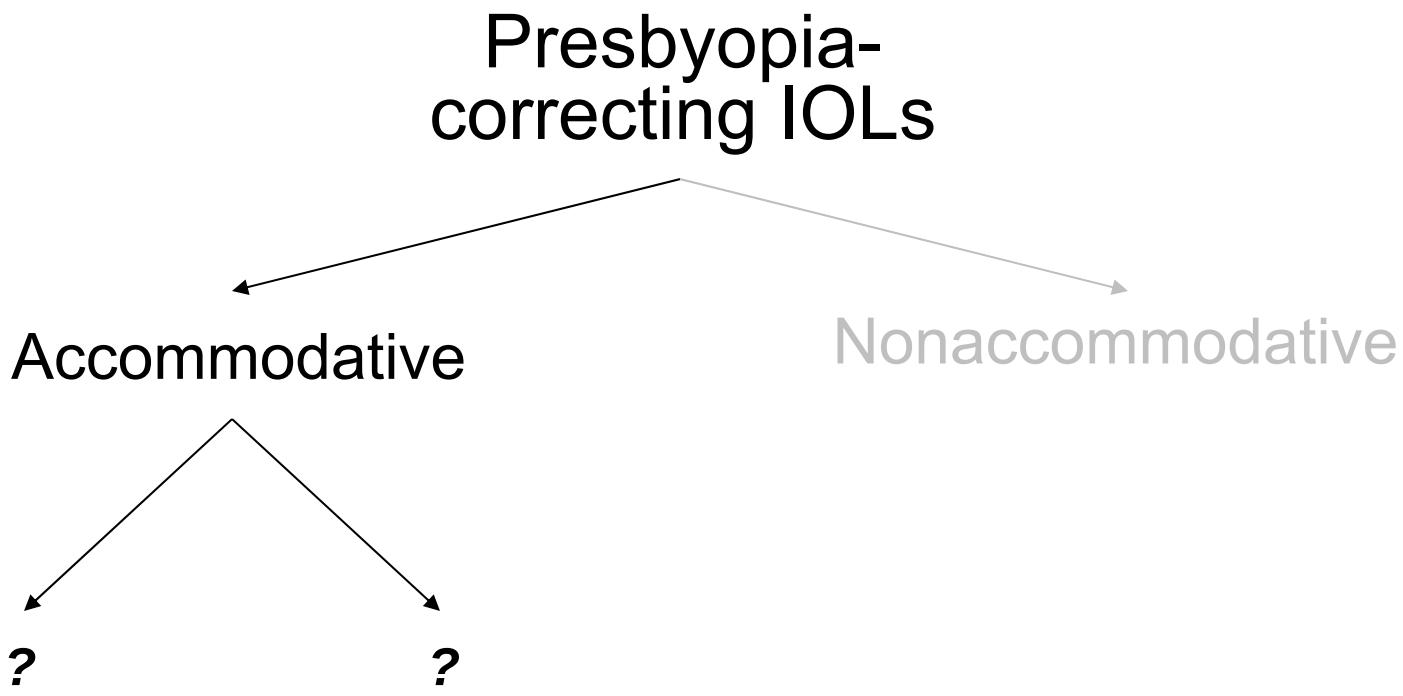


Presbyopia-correcting IOLs

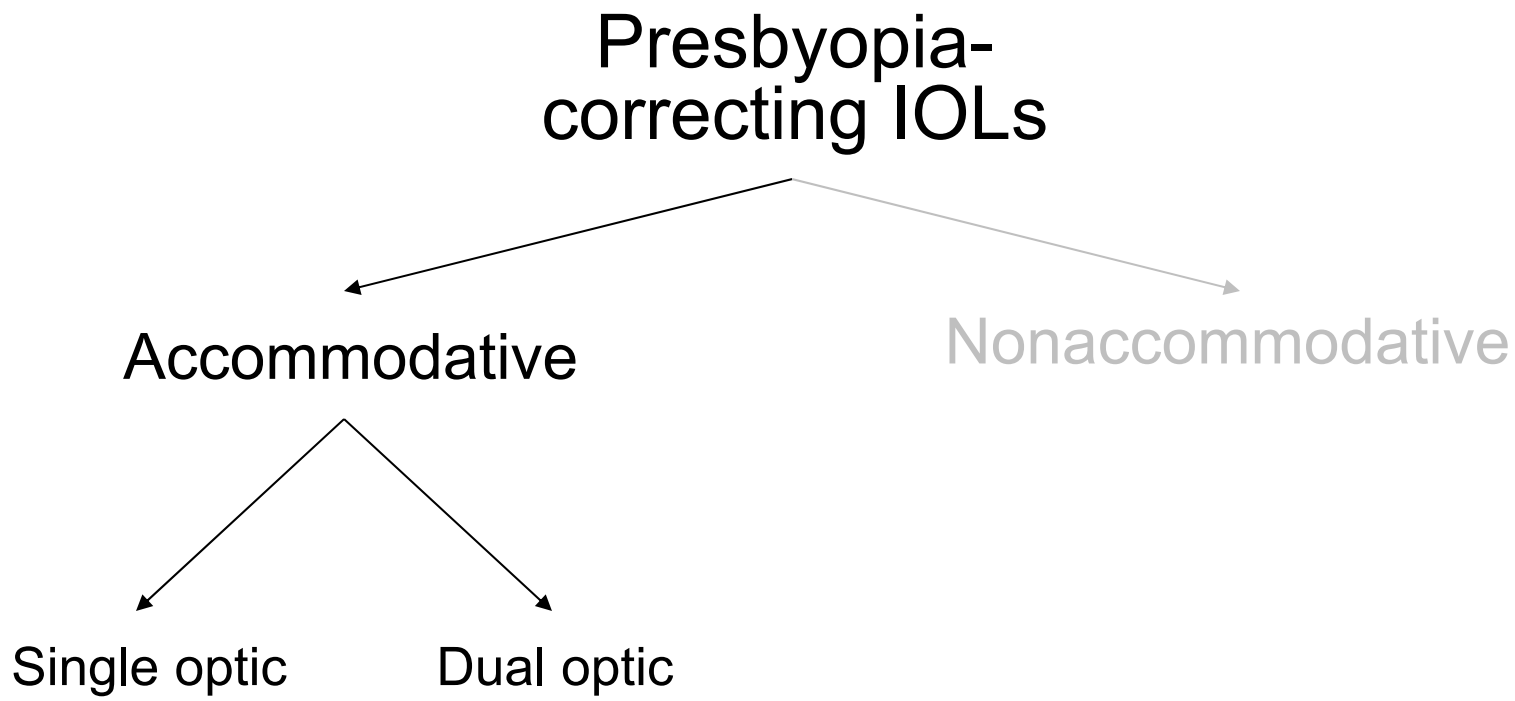
Accommodative

Nonaccommodative

What is the difference between an accommodative *IOL and a n*onaccommodative *IOL?*
To focus at near, an **accommodative** IOL undergoes a conformational change in response to contraction of the ciliary body; ie, it changes focal points by changing shape. In contrast, a **nonaccommodative** IOL does not change conformation; rather, it focuses light from multiple distances simultaneously, and the patient 'selects' which image to devote conscious attention to.



Accommodative IOLs can be divvied up thusly:



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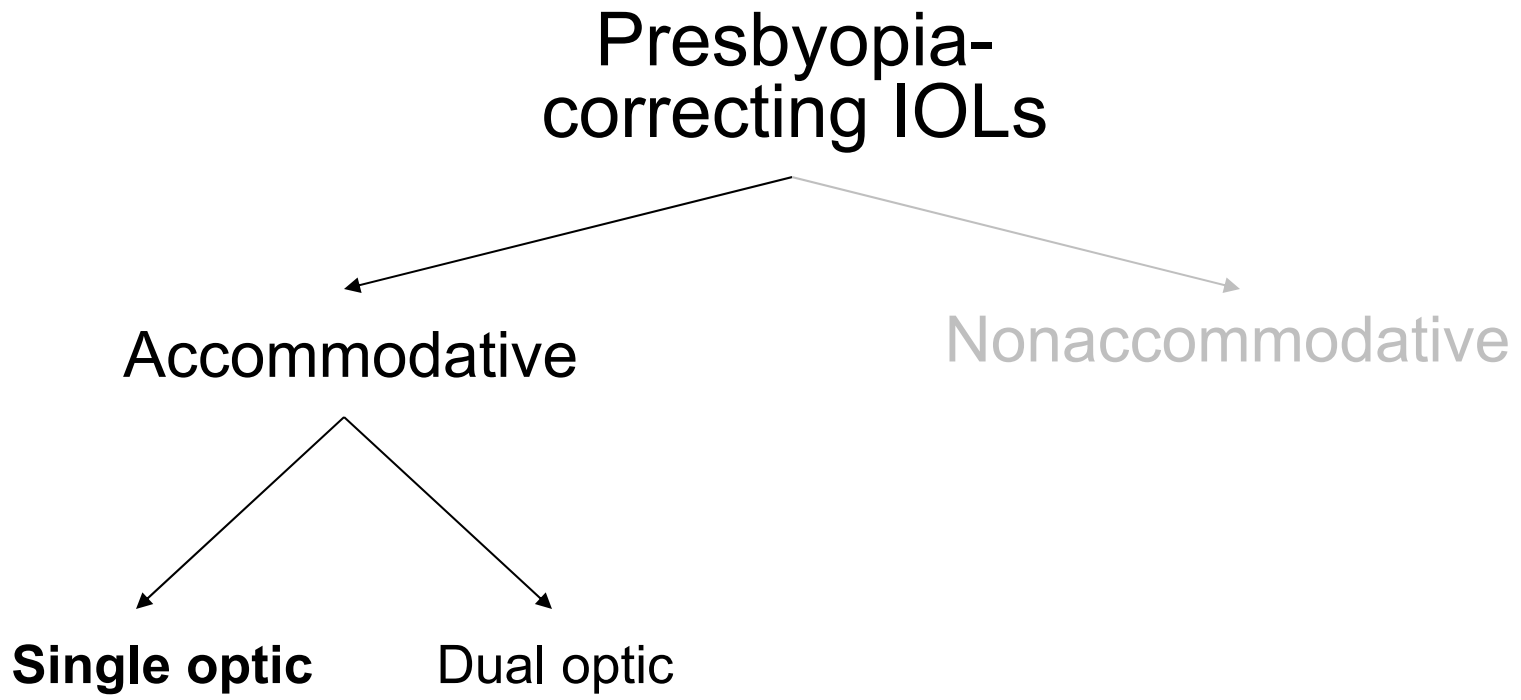
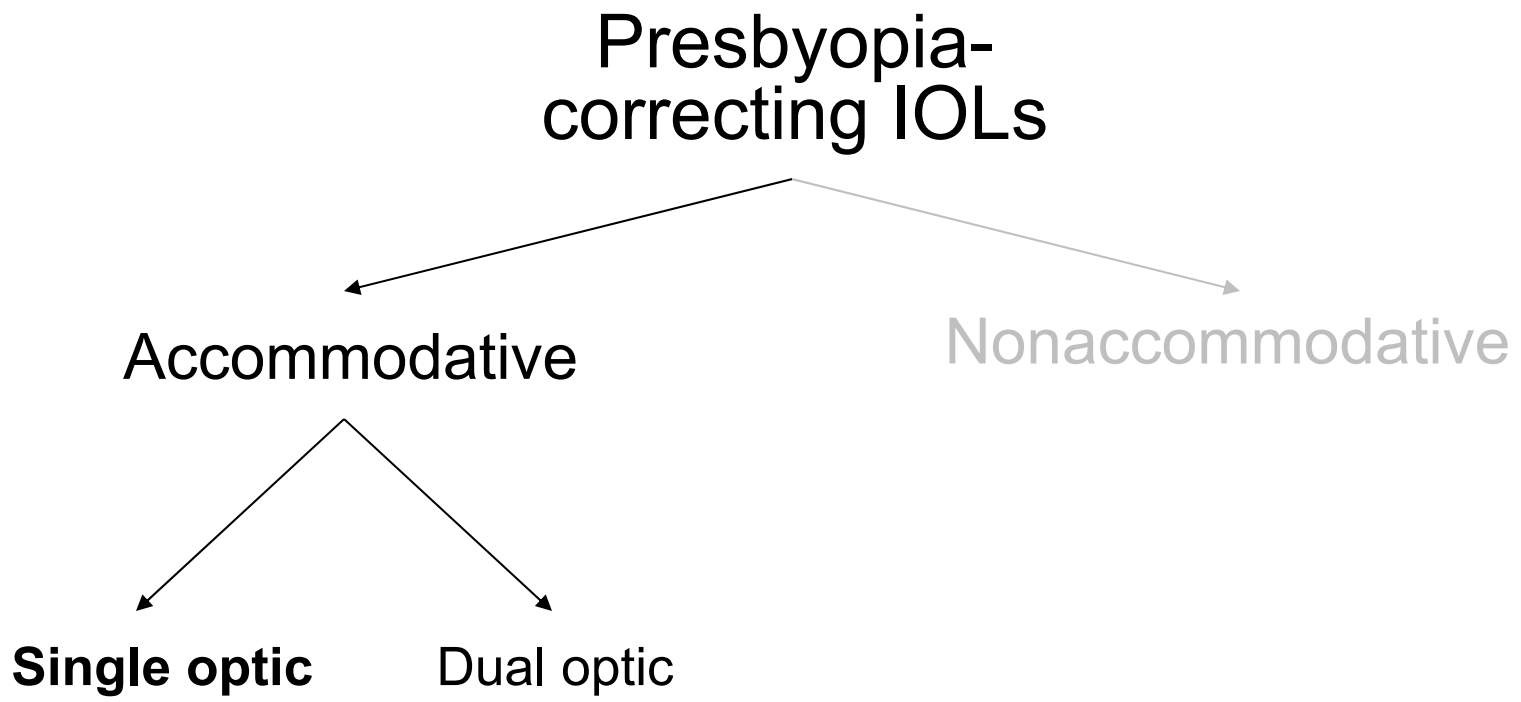
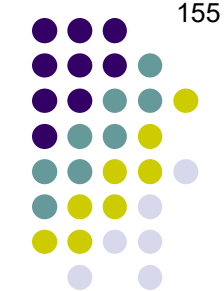
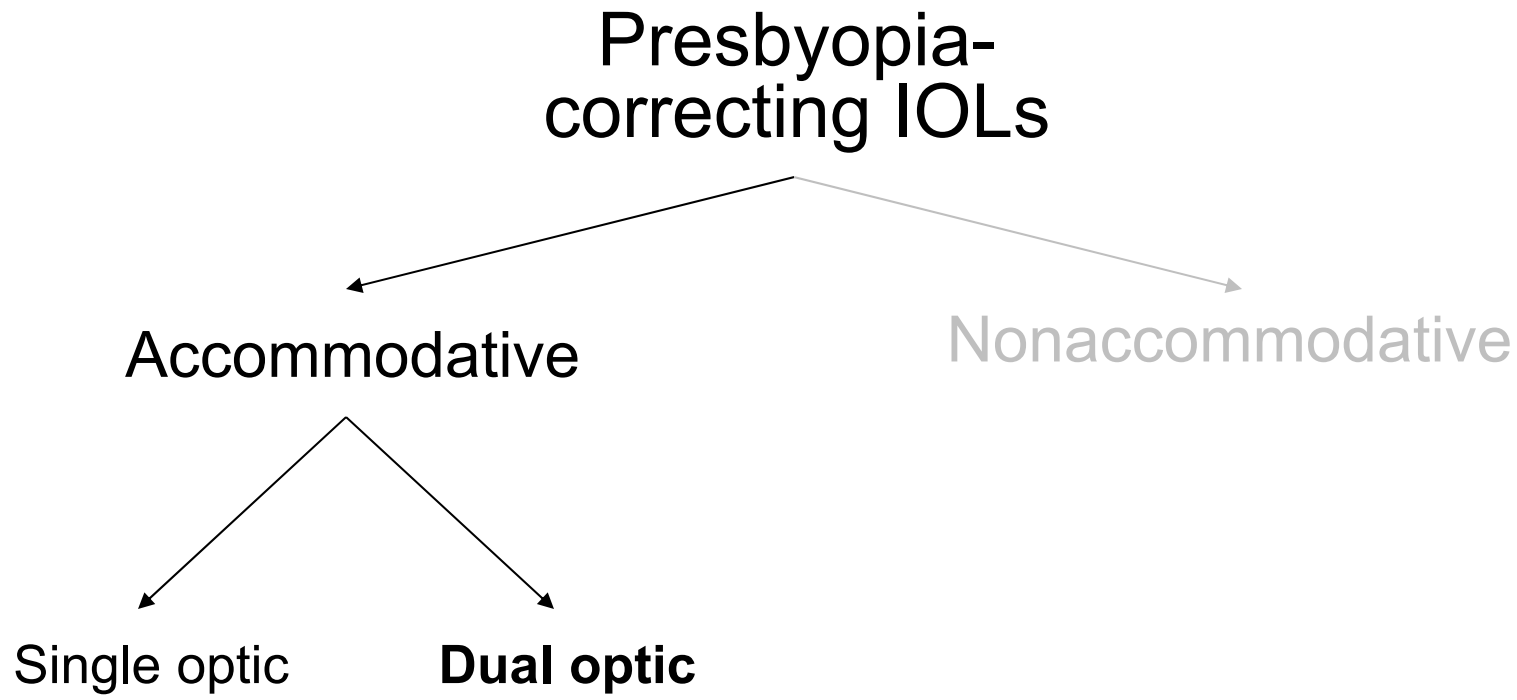


Give an example of each lens type:
Single-optic accommodative: ***?***
Dual-optic accommodative:

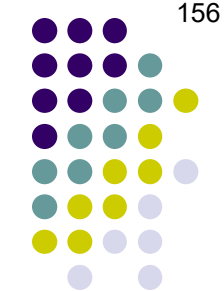


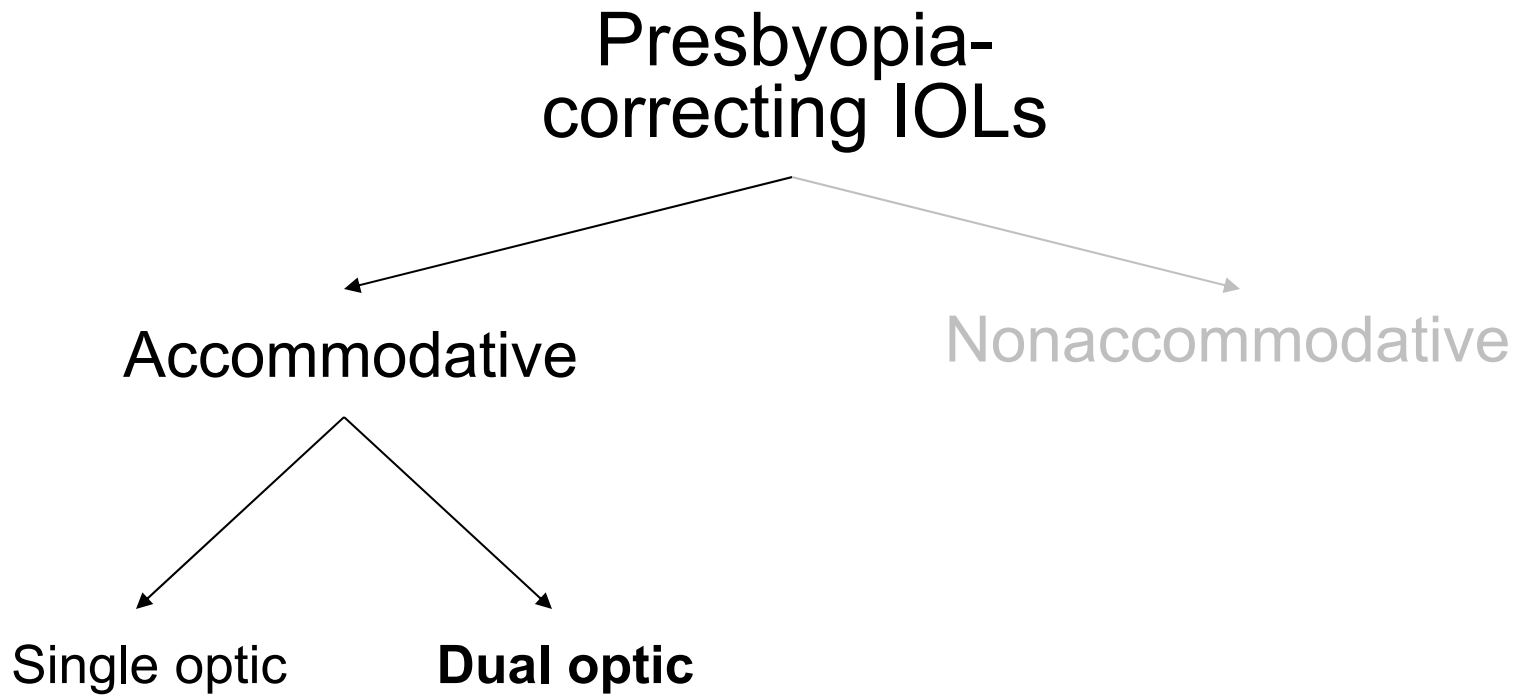
Give an example of each lens type:
Single-optic accommodative: **Crystalens** (B&L)
Dual-optic accommodative



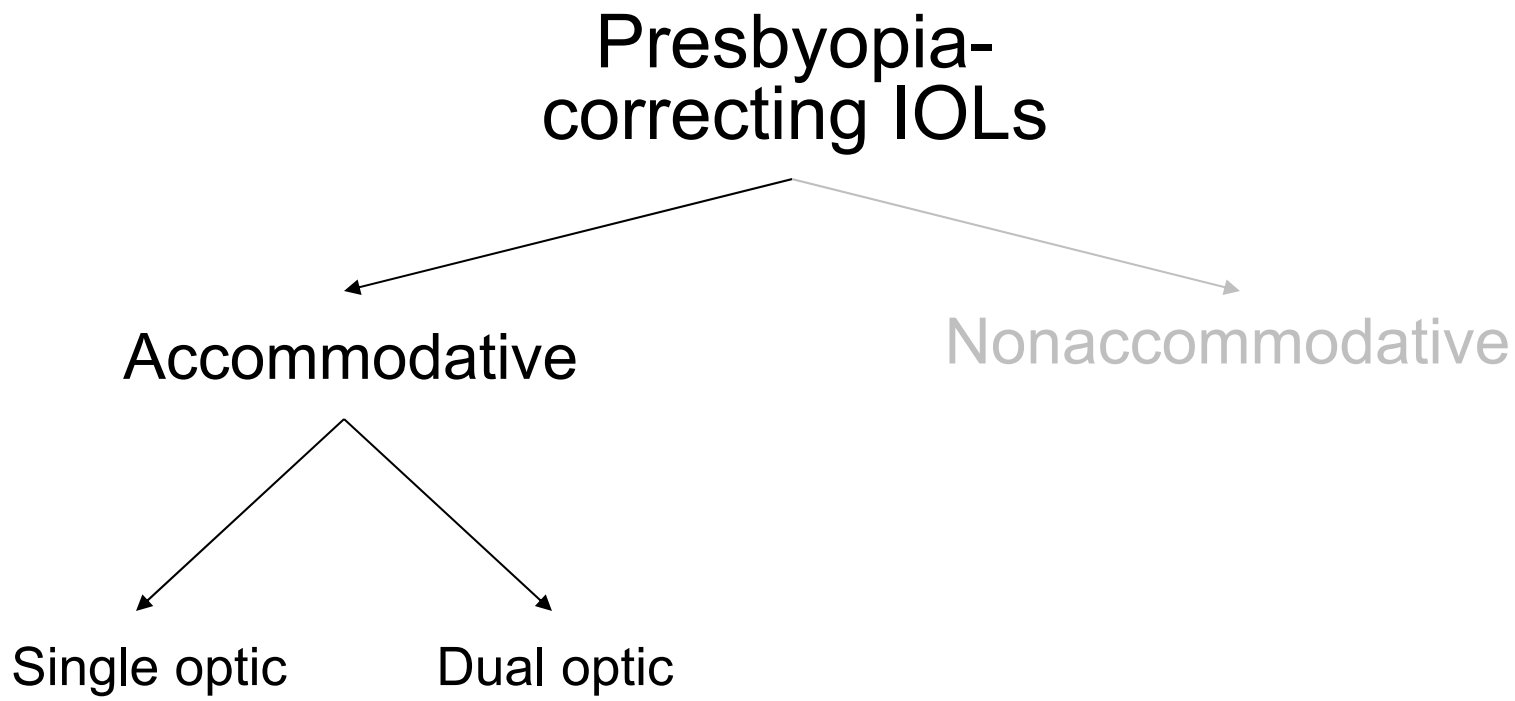


Give an example of each lens type:
Single-optic accommodative: **Crystalens** (B&L)
Dual-optic accommodative: ***?***



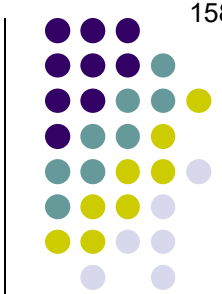


Give an example of each lens type:
Single-optic accommodative: **Crystalens** (B&L)
Dual-optic accommodative: **Synchrony** (Visiogen)



Give an example of each lens type:
Single-optic accommodative: ***Crystalens?*** (B&L)
Dual-optic accommodative: ***Synchrony?*** (Visiogen)

Are both of these available in the US?

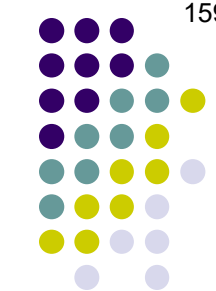


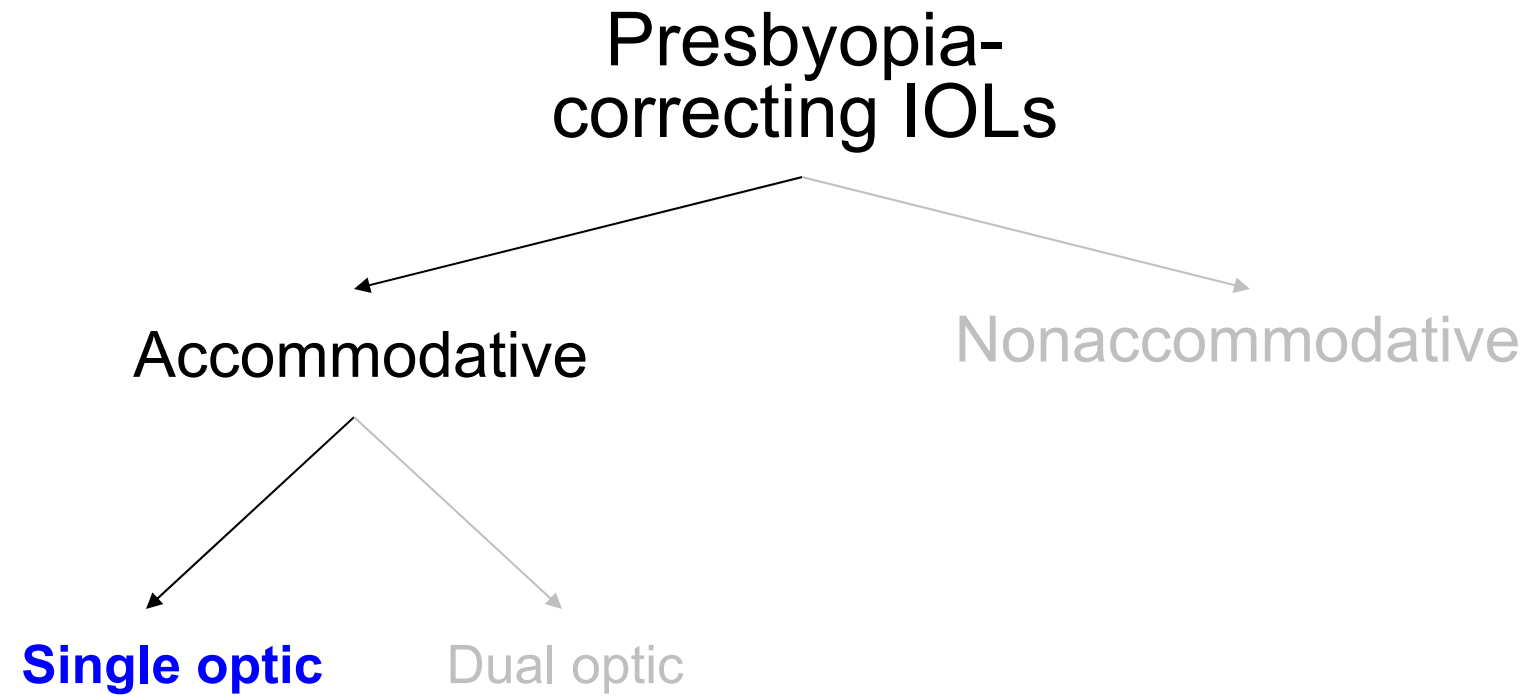
Presbyopia-correcting IOLs

- Accommodative
  - Single optic
  - Dual optic
- Nonaccommodative

Give an example of each lens type:
Single-optic accommodative: **Crystalens!** (B&L)
~~Dual-optic accommodative: **Synchrony** (Visiogen)~~

Are both of these available in the US?
No. While the Crystalens is FDA approved, as of this writing the Synchrony is not, and its application is not active.





How does the Crystalens accommodative IOL work?

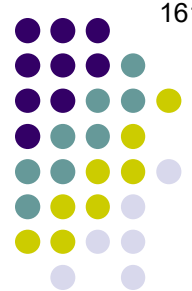
Presbyopia-correcting IOLs

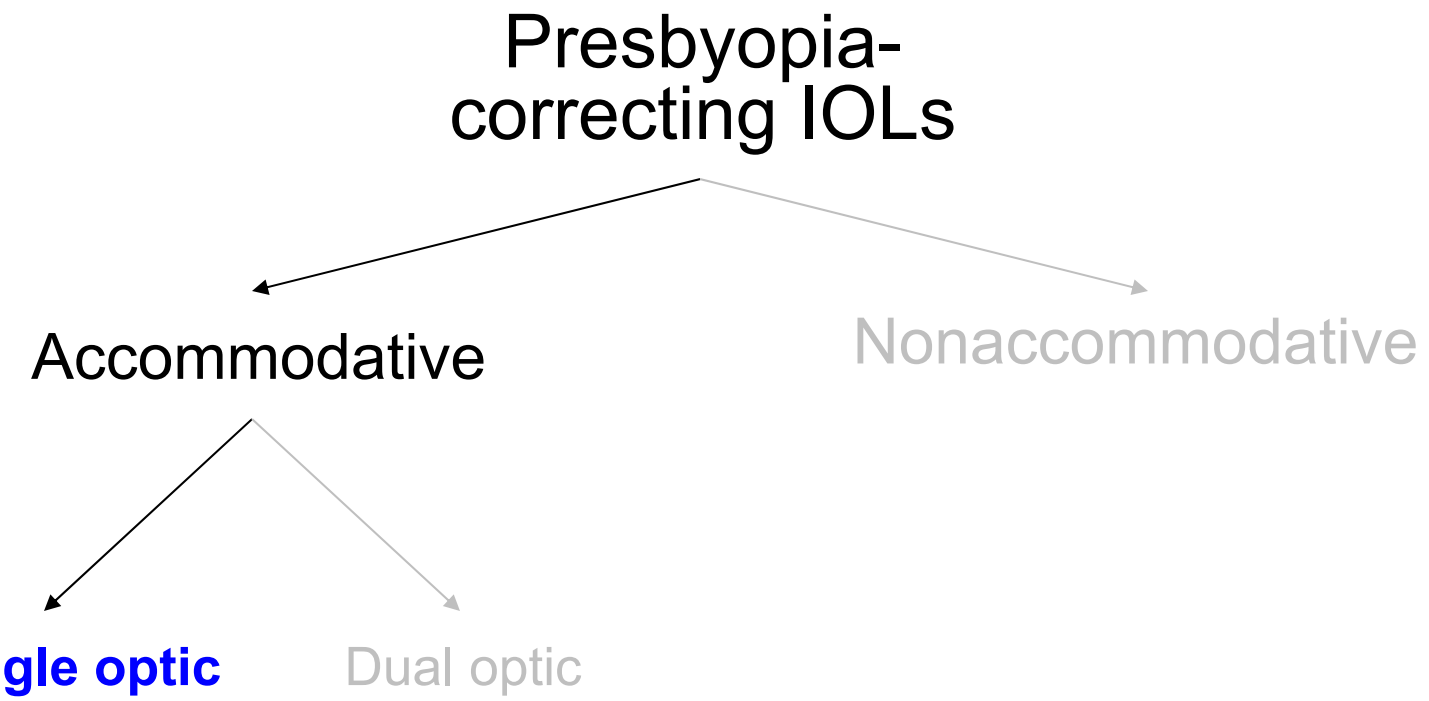
- Accommodative
  - **Single optic**
  - Dual optic
- Nonaccommodative

How does the Crystalens accommodative IOL work?

The Crystalens employs a hinged-haptic design that allows the IOL optic to move in response to accommodative contraction of the ciliary body

forward vs backward





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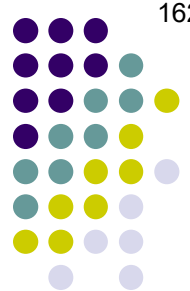

Presbyopia-correcting IOLs

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- Nonaccommodative

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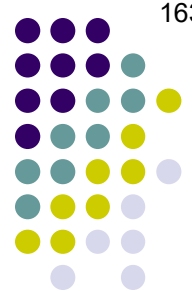
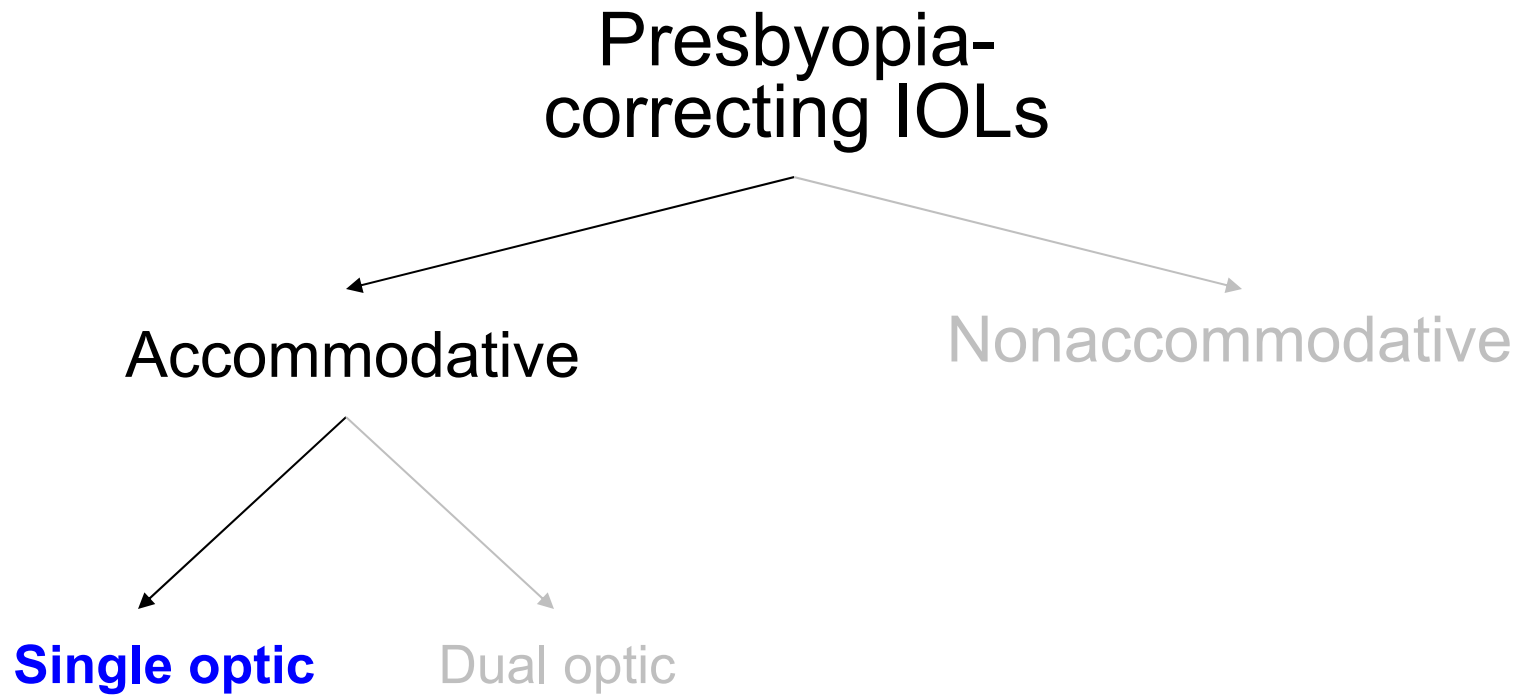
The Crystalens employs a hinged-haptic design that allows the IOL optic to move forward in response to accommodative contraction of the ciliary body. Moving forward [increases vs decraeses] the effective power of the lens, shifting its focal point to [near vs distance]





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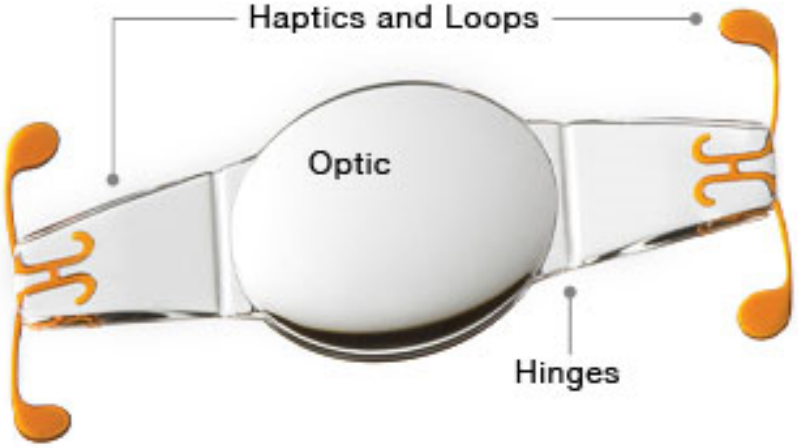

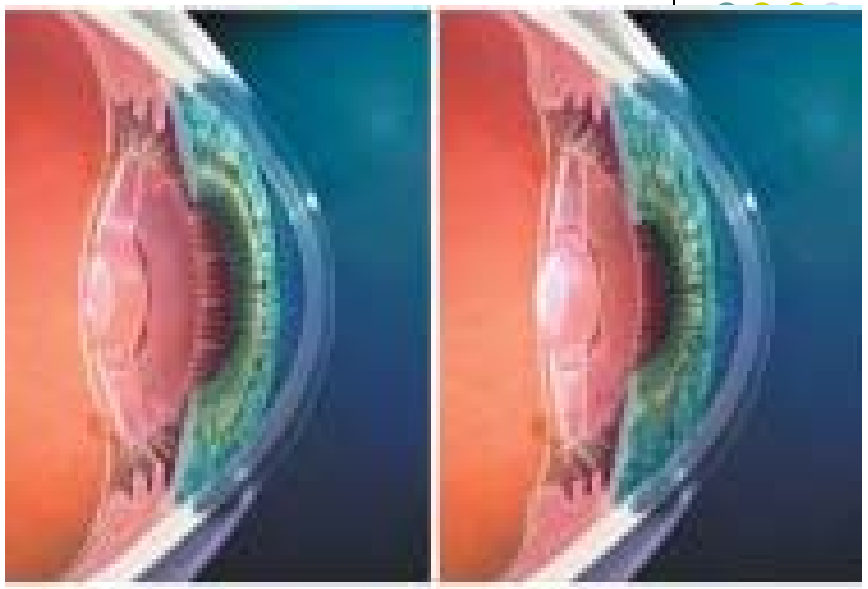

The Crystalens at rest focused for distance vision.

With focusing effort the lens flexes forward focusing for objects closer to you.

Crystalens IOL

Presbyopia-correcting IOLs

- Accommodative
  - **Single optic**
  - Dual optic
- Nonaccommodative

How does the Crystalens accommodative IOL work?

The Crystalens employs a hinged-haptic design that allows the IOL optic to move forward in response to accommodative contraction of the ciliary body. Moving forward **increases the effective power of the lens, shifting its focal point to near.**

How effective is the Crystalens in terms of accommodative power?

Presbyopia-correcting IOLs

- Accommodative
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How does the Crystalens accommodative IOL work?
The Crystalens employs a hinged-haptic design that allows the IOL optic to move forward in response to accommodative contraction of the ciliary body. Moving forward **increases the effective power of the lens, shifting its focal point to near.**

How effective is the Crystalens in terms of accommodative power?
'Meh' at best. Most pts enjoy no more than about 1D of accommodation.

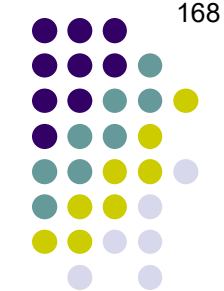
Presbyopia-correcting IOLs

- Accommodative
  - **Single optic**
  - Dual optic
- Nonaccommodative

How does the Crystalens accommodative IOL work?

The Crystalens employs a hinged-haptic design that allows the IOL optic to **move forward** in response to accommodative contraction of the ciliary body. Moving forward increases the effective power of t

How robust is the Crystalens in terms of forward movement?



Presbyopia-correcting IOLs

- Accommodative
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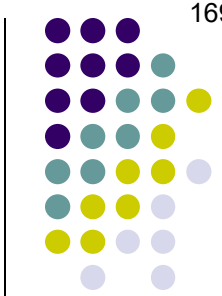
How robust is the Crystalens in terms of forward movement?

Worse than 'meh.' To date, no study has been able to provide objective evidence of an actual change in the axial position of the optic during accommodation.



Presbyopia-correcting IOLs

Accommodative

Nonaccommodative

Single optic

If the Crystalens optic doesn't move forward, how does it supply its diopter of accommodation?

move forward?

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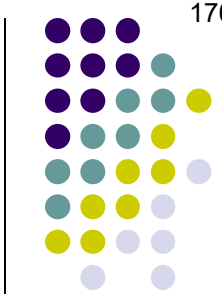

Presbyopia-correcting IOLs

Accommodative

Nonaccommodative

Single optic

How does the Crystalens
The Crystalens employs
in response to accommo
the effective power of

If the Crystalens optic doesn't move forward, how does it supply its diopter of accommodation?
This is not a settled issue, but it *probably* derives from a conformational change of the optic owing to pressure applied to it when the vitreous moves forward slightly during accommodation

move forward?

How robust is the Crystalens in terms of forward movement?
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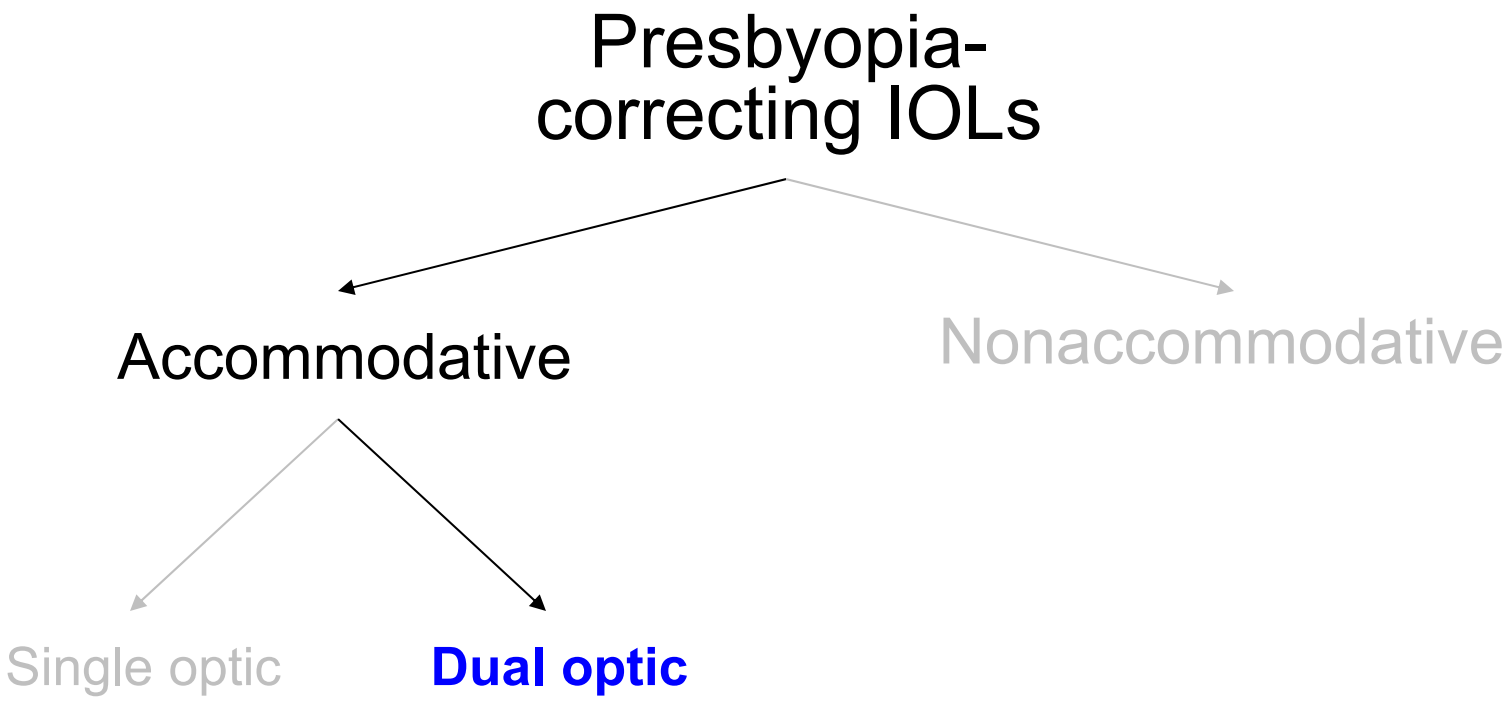
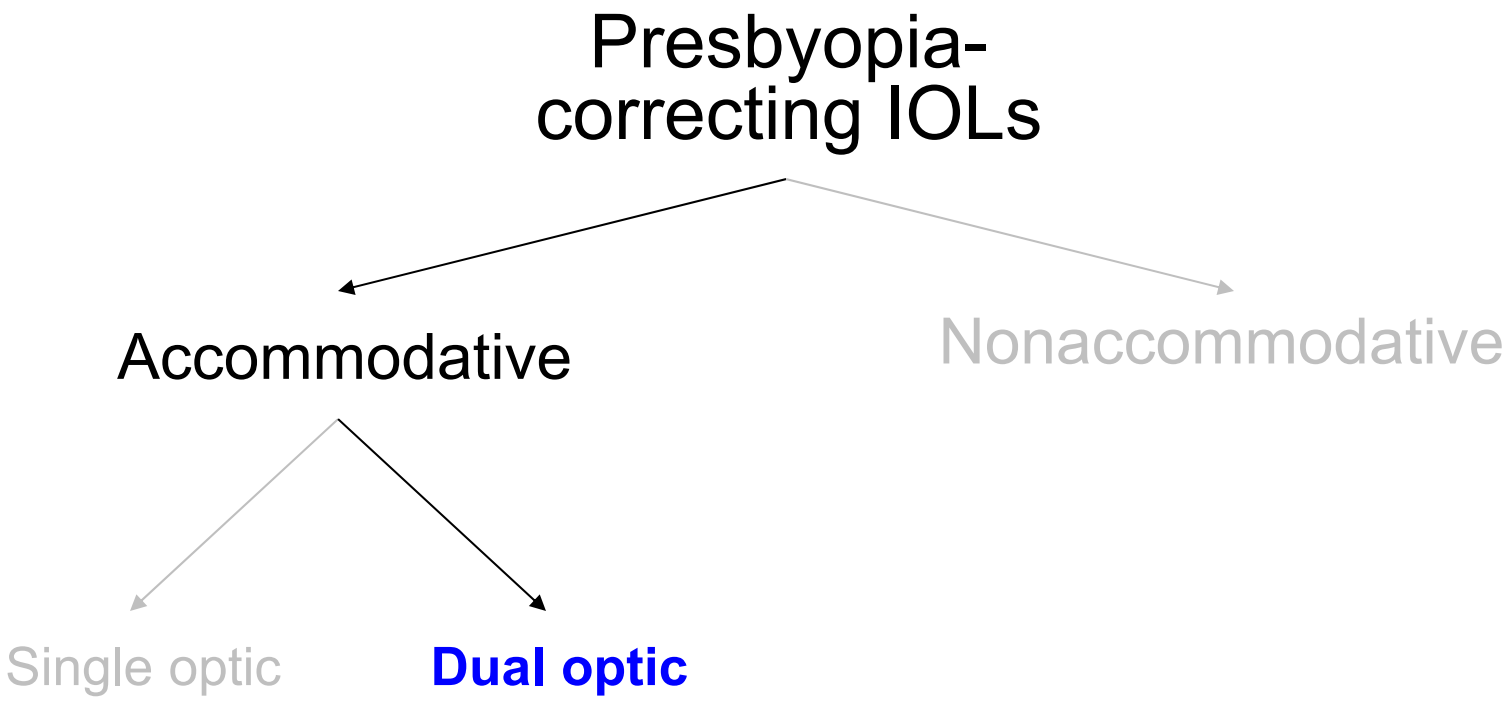
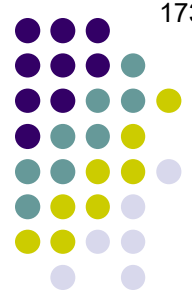
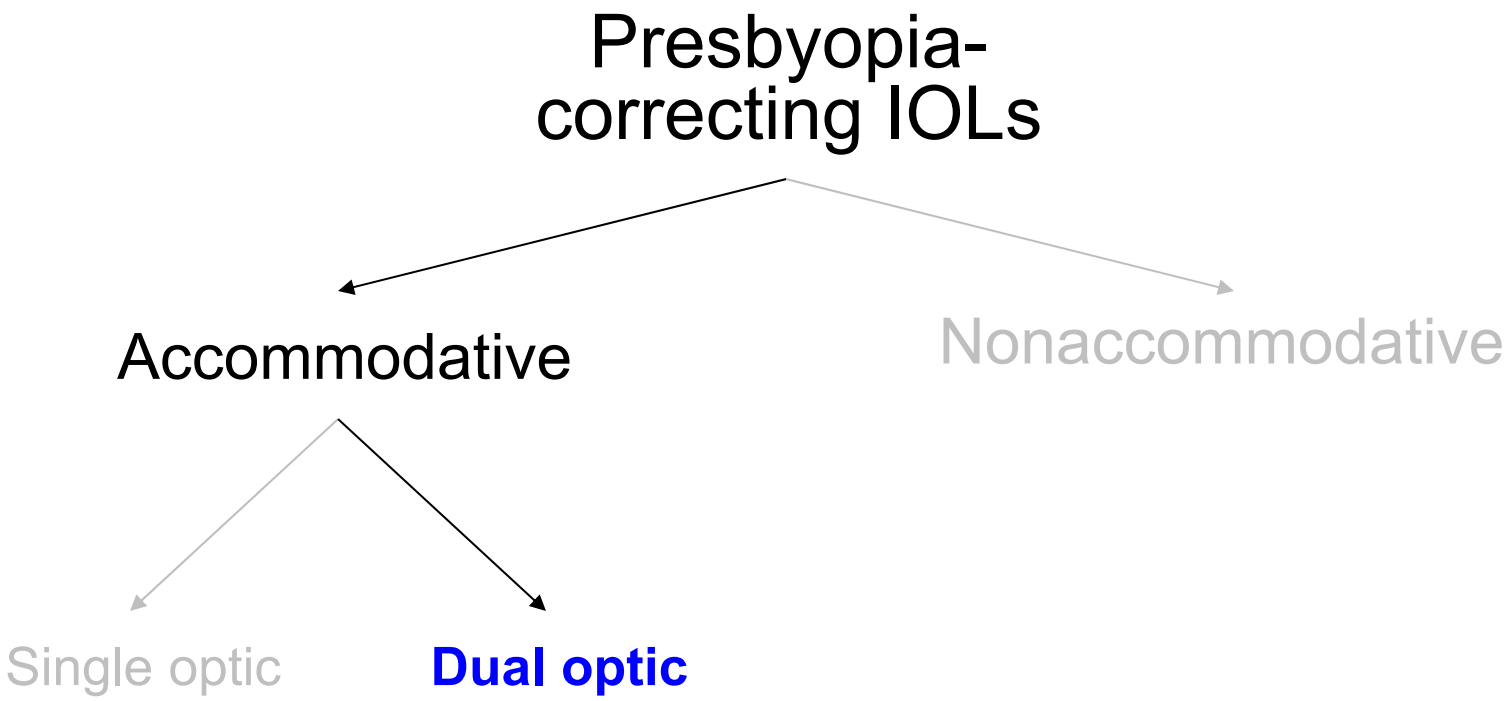


How does the Synchrony dual-optic accommodative IOL work?



How does the Synchrony dual-optic accommodative IOL work?
The Synchrony employs an anterior high-plus optic in line with a posterior moderately-powered minus optic. The two optics are connected peripherally by spring-like haptics.





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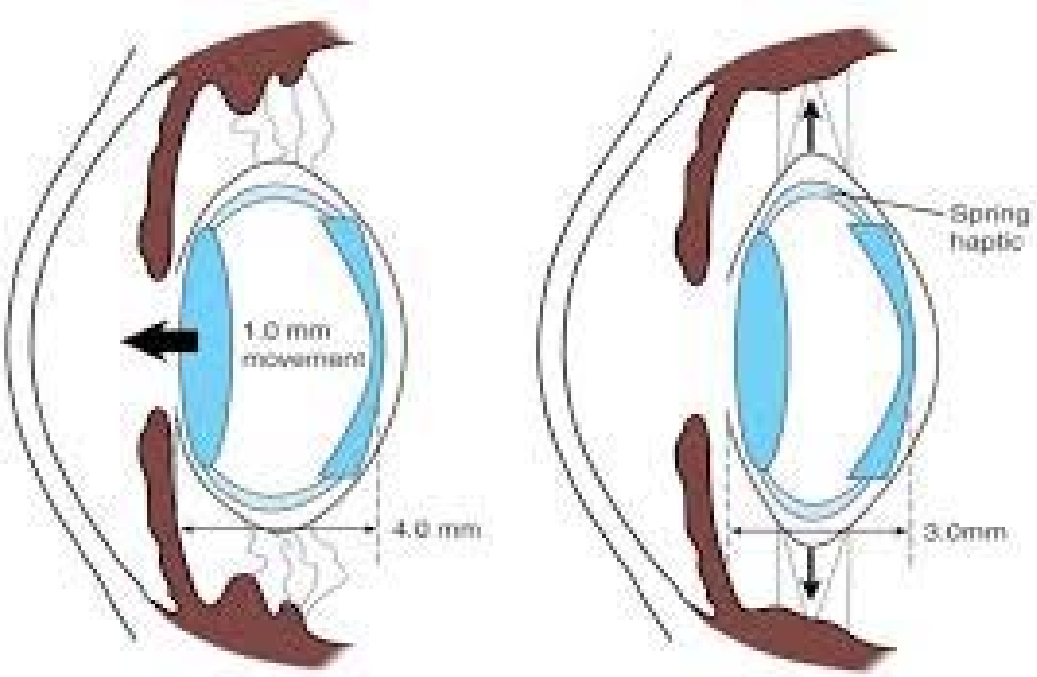
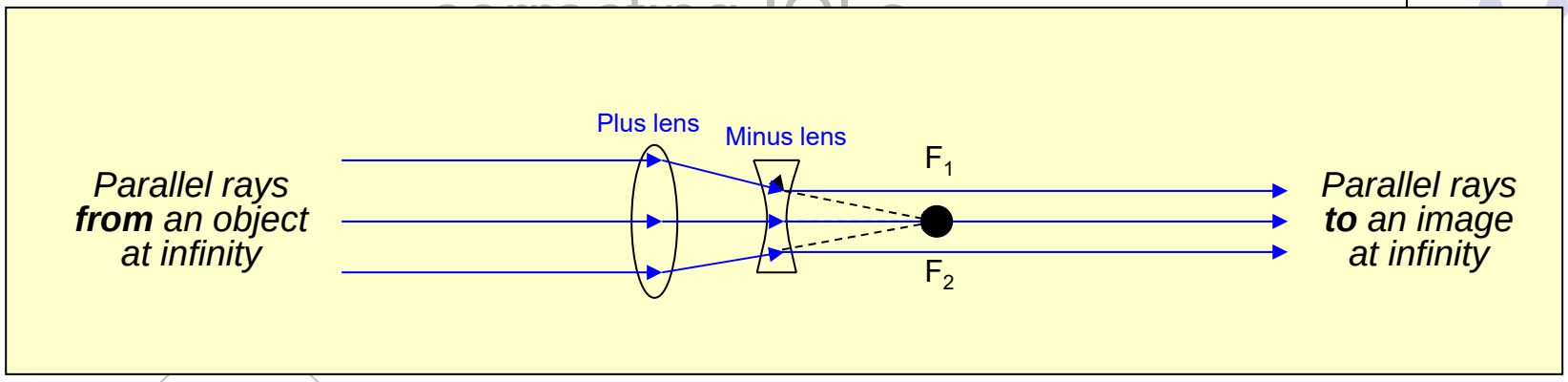
The Synchrony employs an anterior high-plus optic in line with a posterior moderately-powered minus optic. The two optics are connected peripherally by spring-like haptics. Contraction of the ciliary body allows the anterior plus lens to move forward, shifting the focal point to the near range.



Synchrony IOL

Presbyopia-



Hmmm…A device consisting of an anterior plus lens and a posterior minus lens—what familiar optical instrument does that sound like?

Single optic **Dual optic**

How does the Synchrony dual-optic accommodative IOL work?

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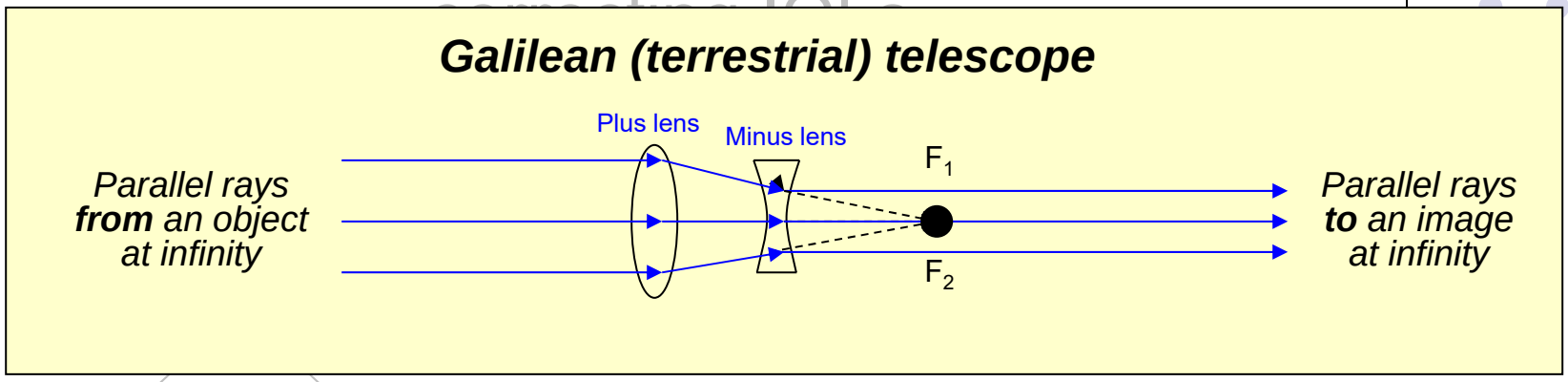
Presbyopia-correcting IOLs



Single optic

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A Galilean telescope

How does the Synchrony dual-optic accommodative IOL work?

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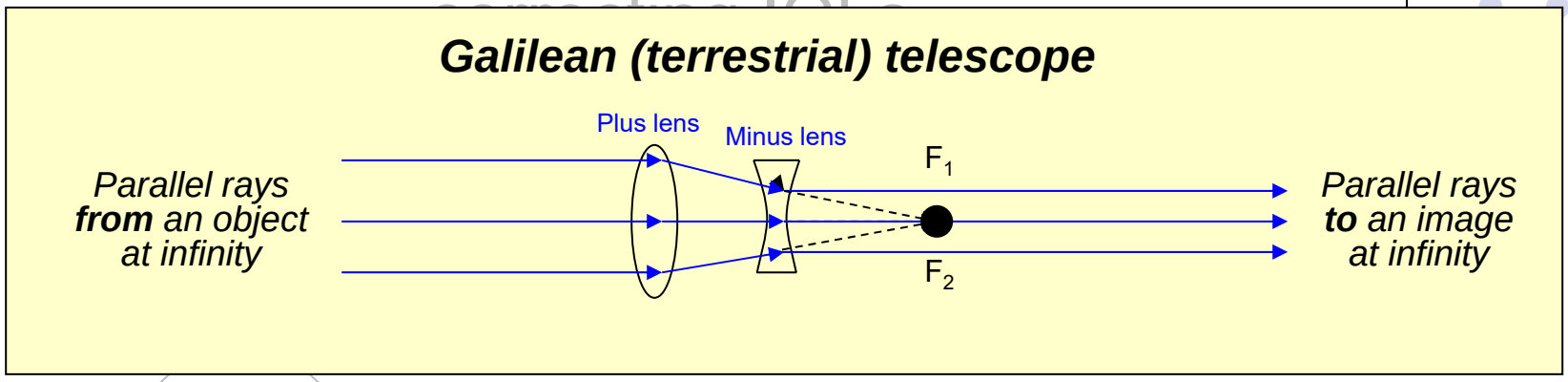
Presbyopia-



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Single o

In what important way is a dual-optic IOL **not** *like a Galilean telescope?*

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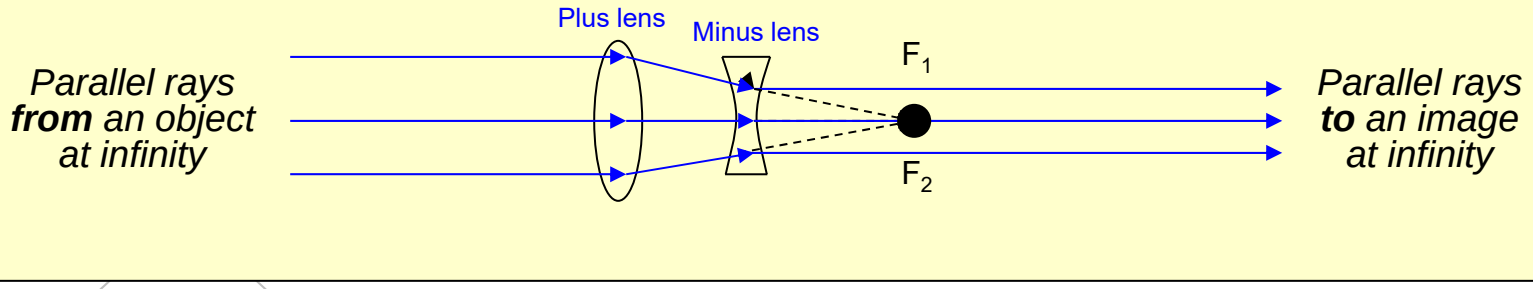
Presbyopia-

Galilean (terrestrial) telescope



Hmmm... A device consisting of an anterior plus lens

Single o

In what important way is a dual-optic IOL **not** *like a Galilean telescope?*
In the dual-optic IOL the plus lens is of significantly higher power than the minus lens, whereas in a Galilean telescope the opposite is true.

How does the Synchrony dual-optic accommodative IOL work?
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Presbyopia-

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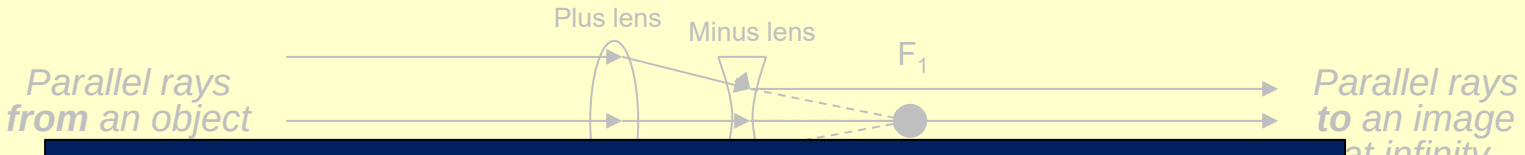

For more on telescopes, see slide-set BO23

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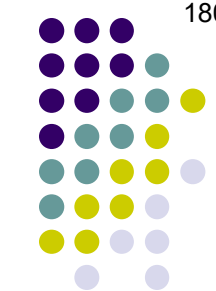

Presbyopia-correcting IOLs

- Accommodative
  - Single optic
  - Dual optic
- Nonaccommodative
  - ?
  - ?

Nonaccommodative IOLs
come in two basic flavors:

Presbyopia-correcting IOLs

- Accommodative
  - Single optic
  - Dual optic
- Nonaccommodative
  - Multifocal
  - EDOF

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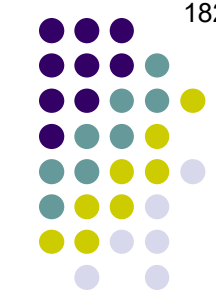
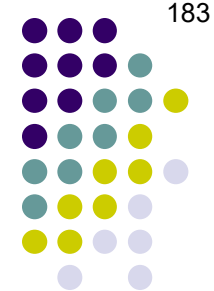


Presbyopia-correcting IOLs

- Accommodative
  - Single optic
  - Dual optic
- Nonaccommodative
  - Multifocal
  - **EDOF**

What does EDOF *stand for in this context?*



Presbyopia-correcting IOLs

- Accommodative
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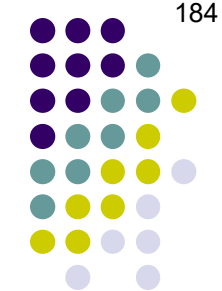
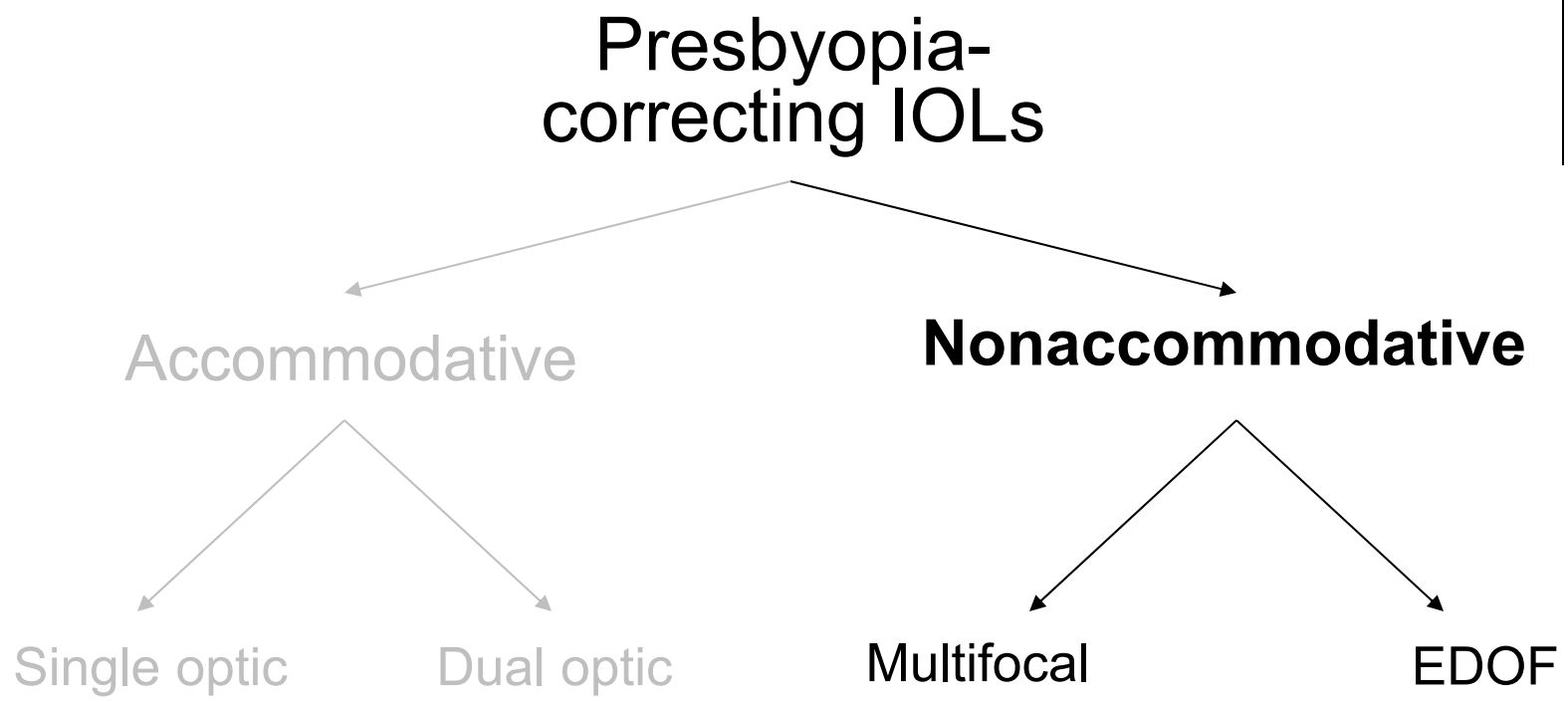
- Nonaccommodative
  - Multifocal
  - **EDOF**

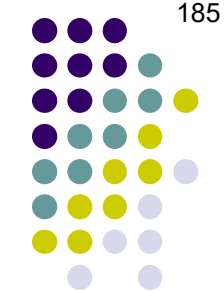
What does EDOF *stand for in this context?*

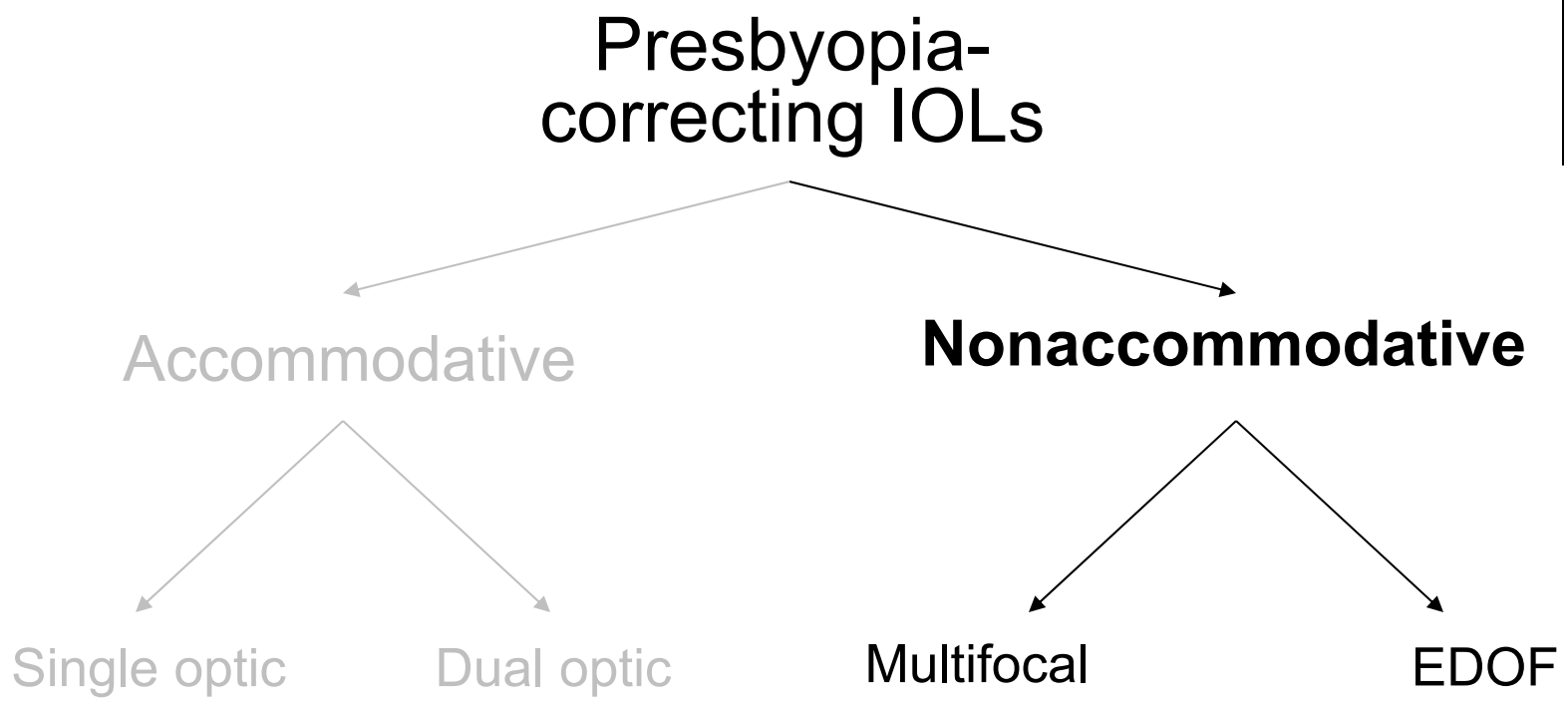
'Extended depth of focus'



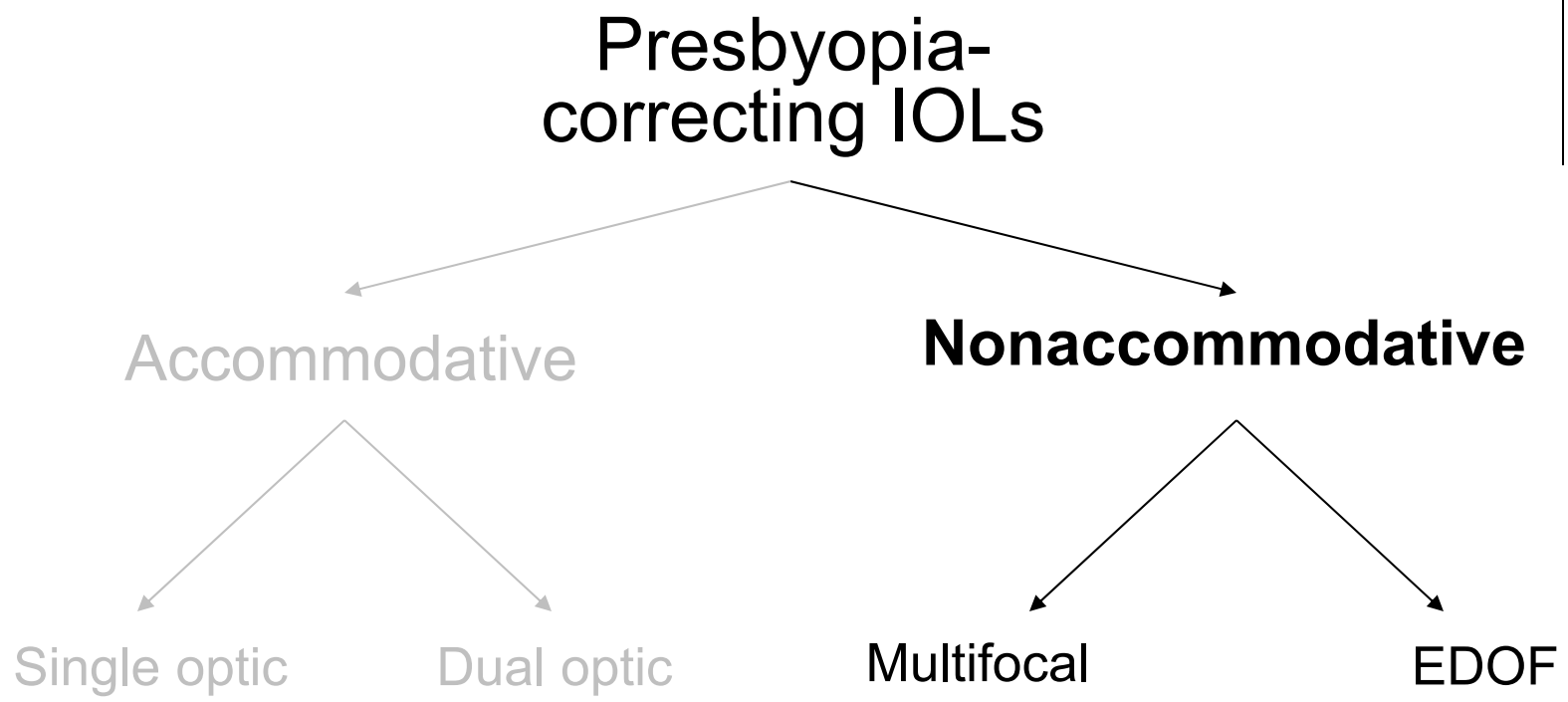


Generally speaking, how do nonaccommodative IOLs facilitate vision at multiple distances?





Generally speaking, how do nonaccommodative IOLs facilitate vision at multiple distances?
The IOL segregates the incoming light and focuses it at two or more points simultaneously. The pt's visual/attentional system then selects an image to process further.



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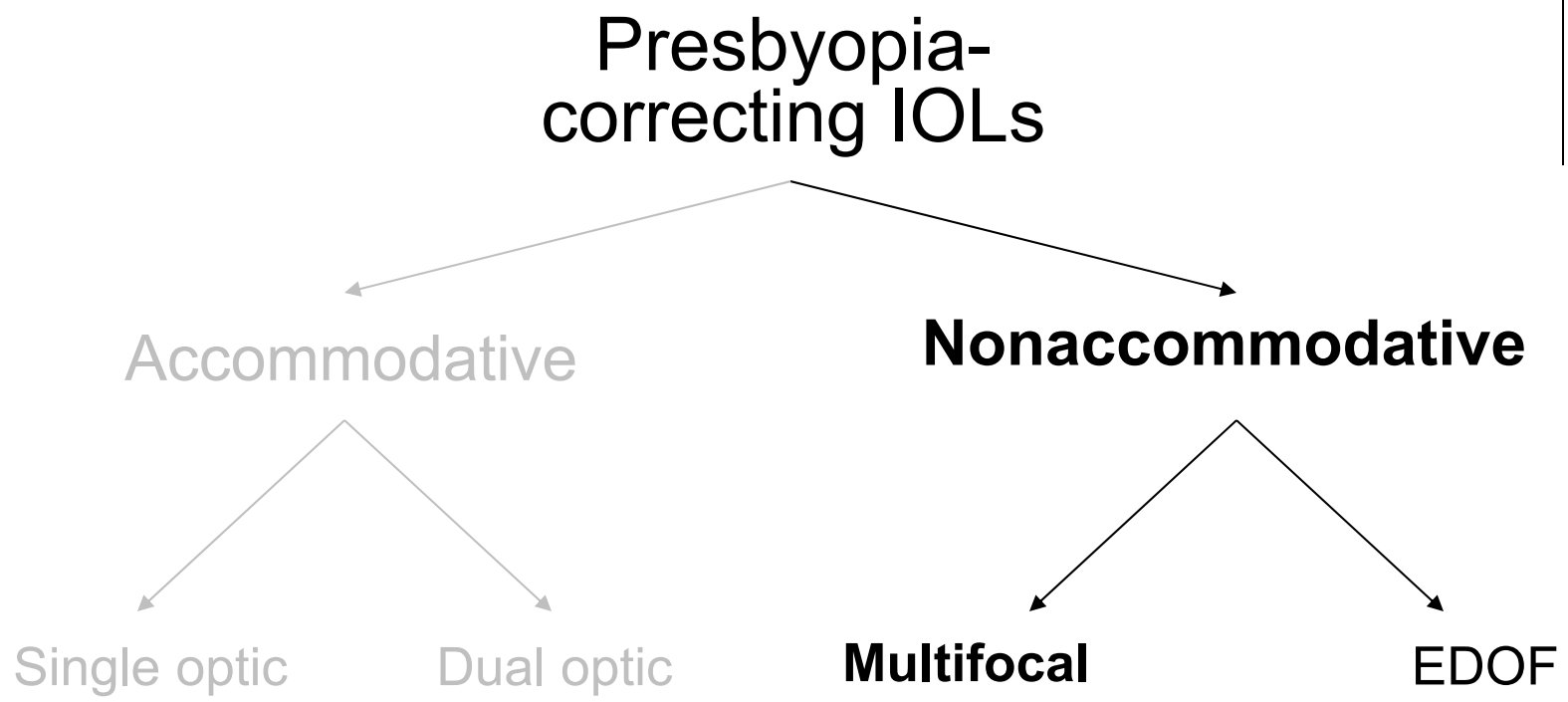

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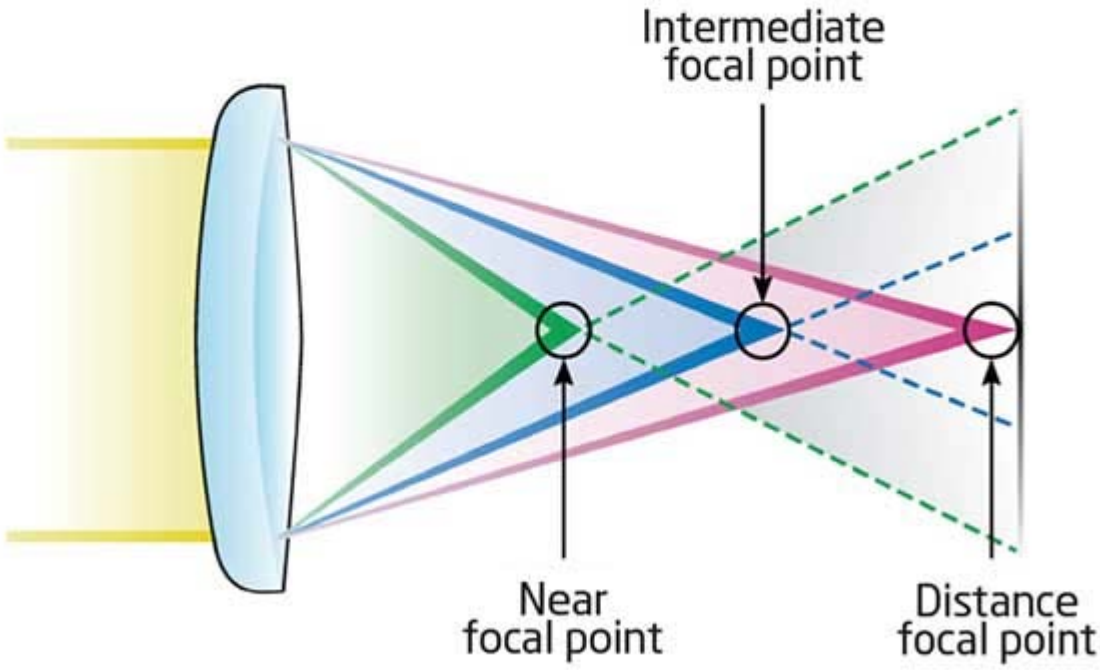
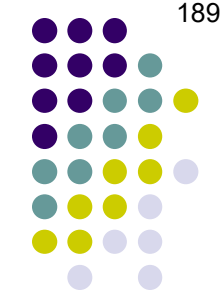


Multifocal optics



Presbyopia-correcting IOLs

- Accommodative
  - Single optic
  - Dual optic
- **Nonaccommodative**
  - Multifocal
  - **EDOF**

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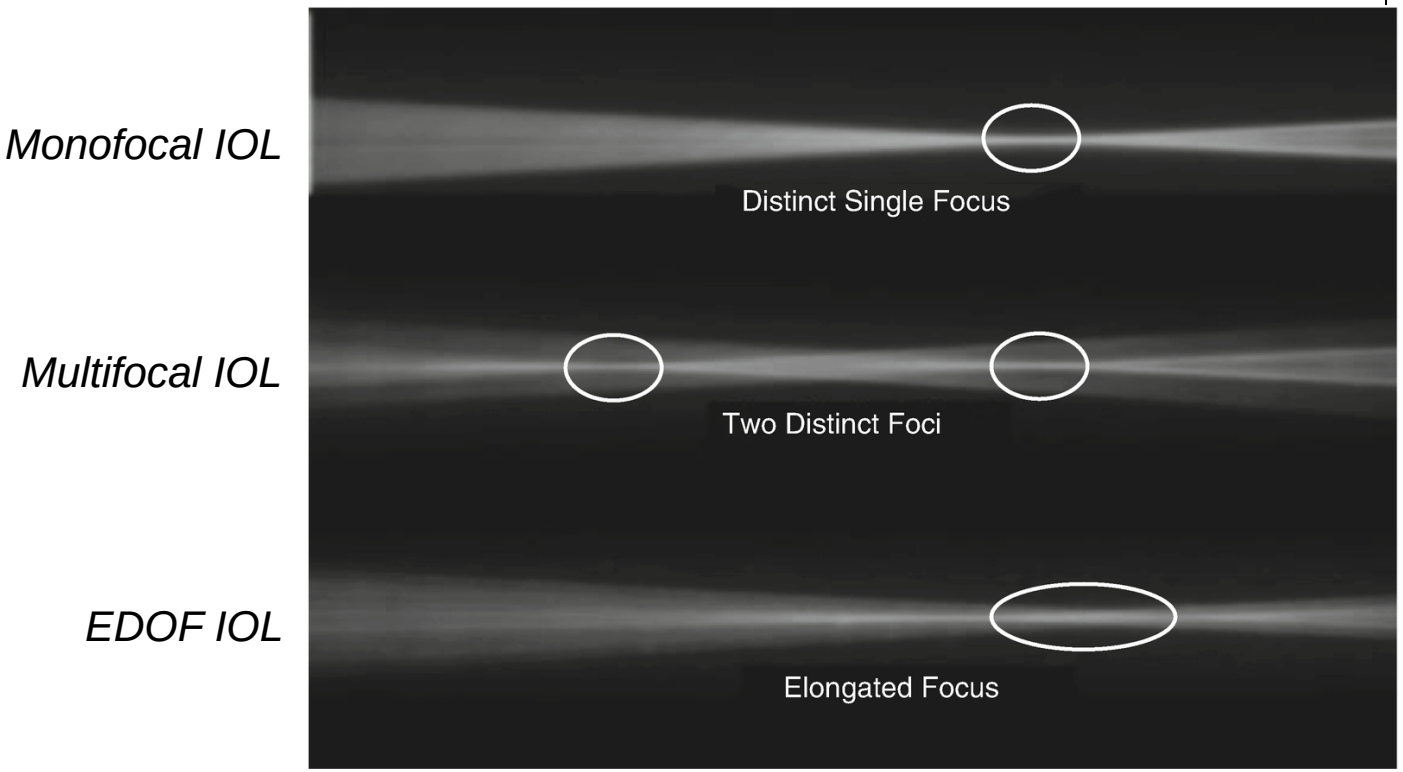
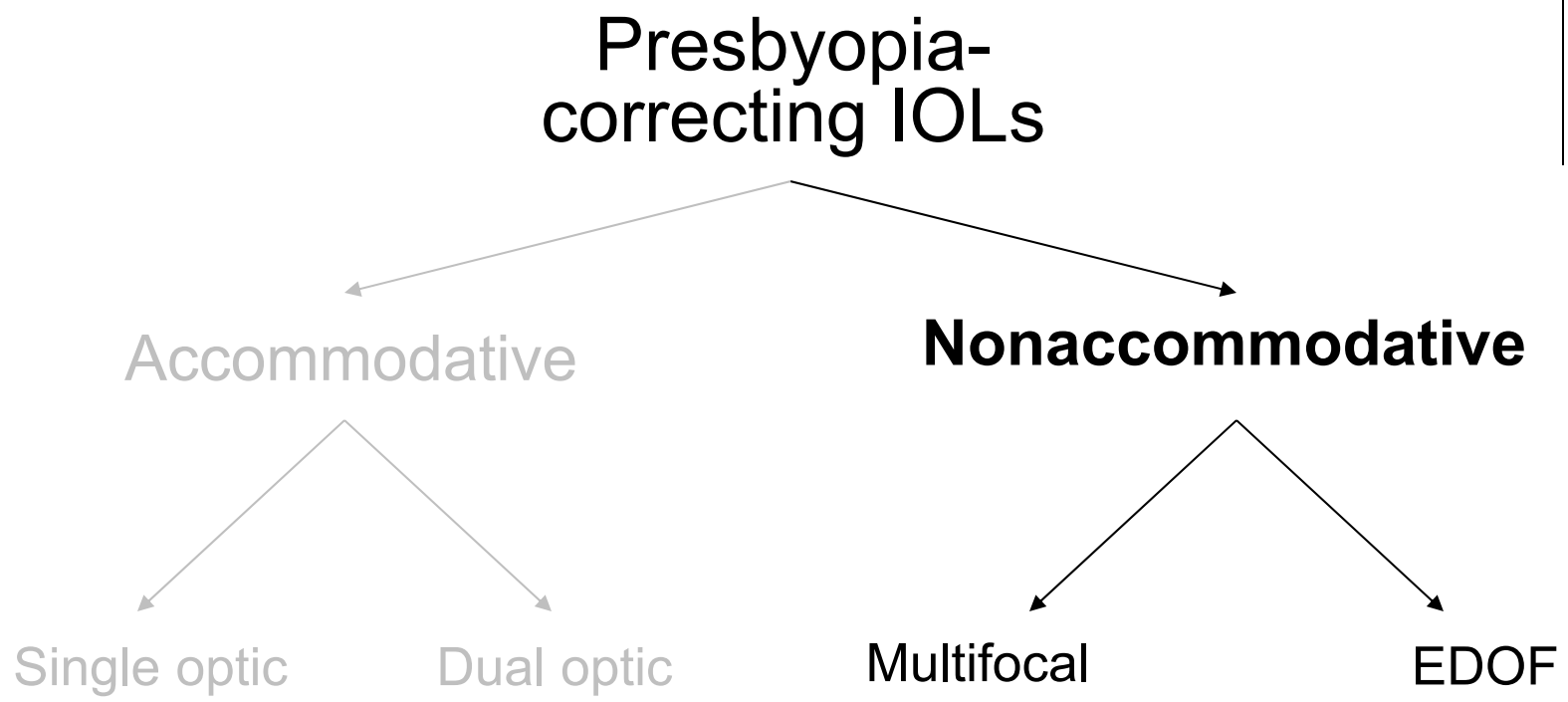


Comparison of technologies



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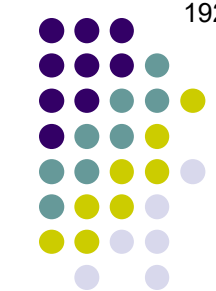

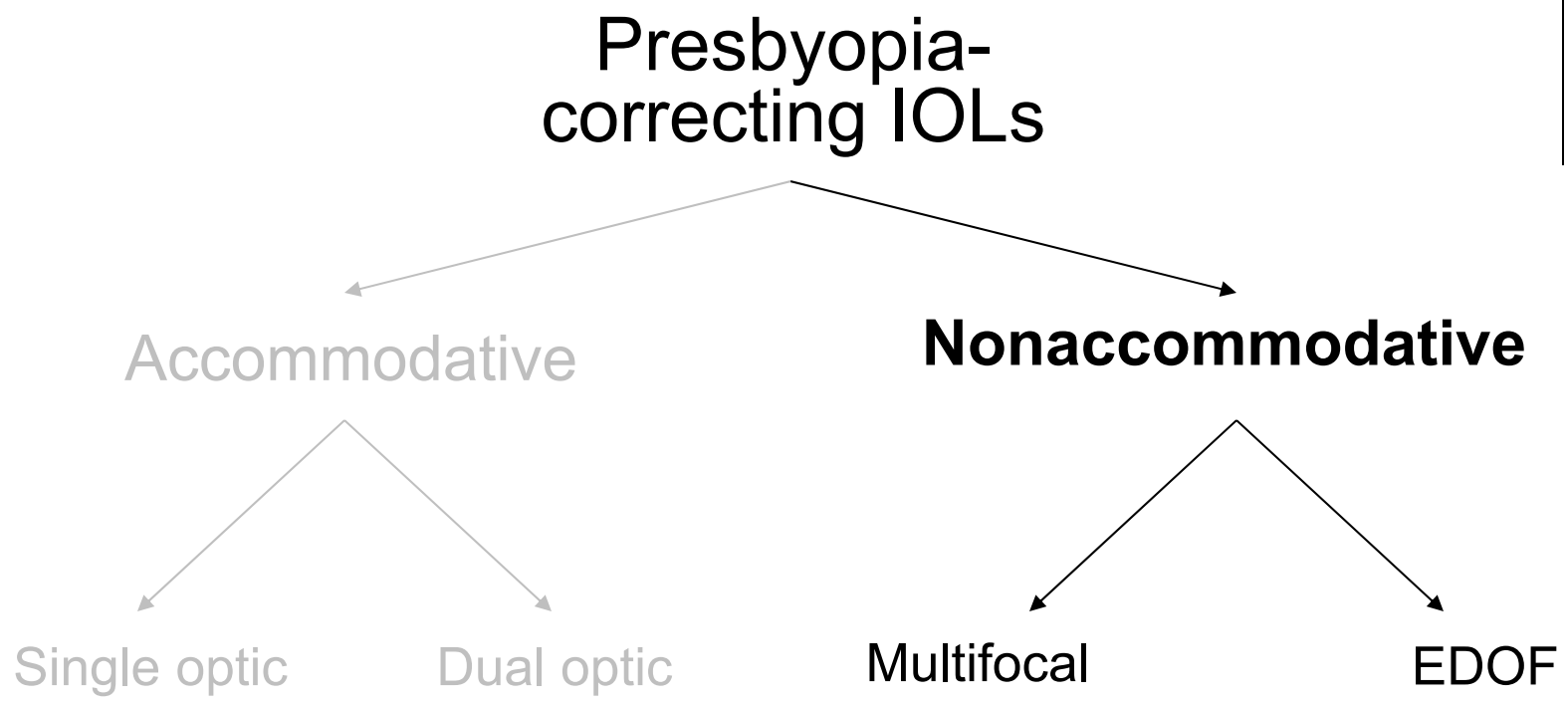

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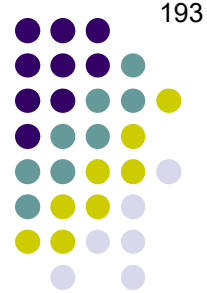
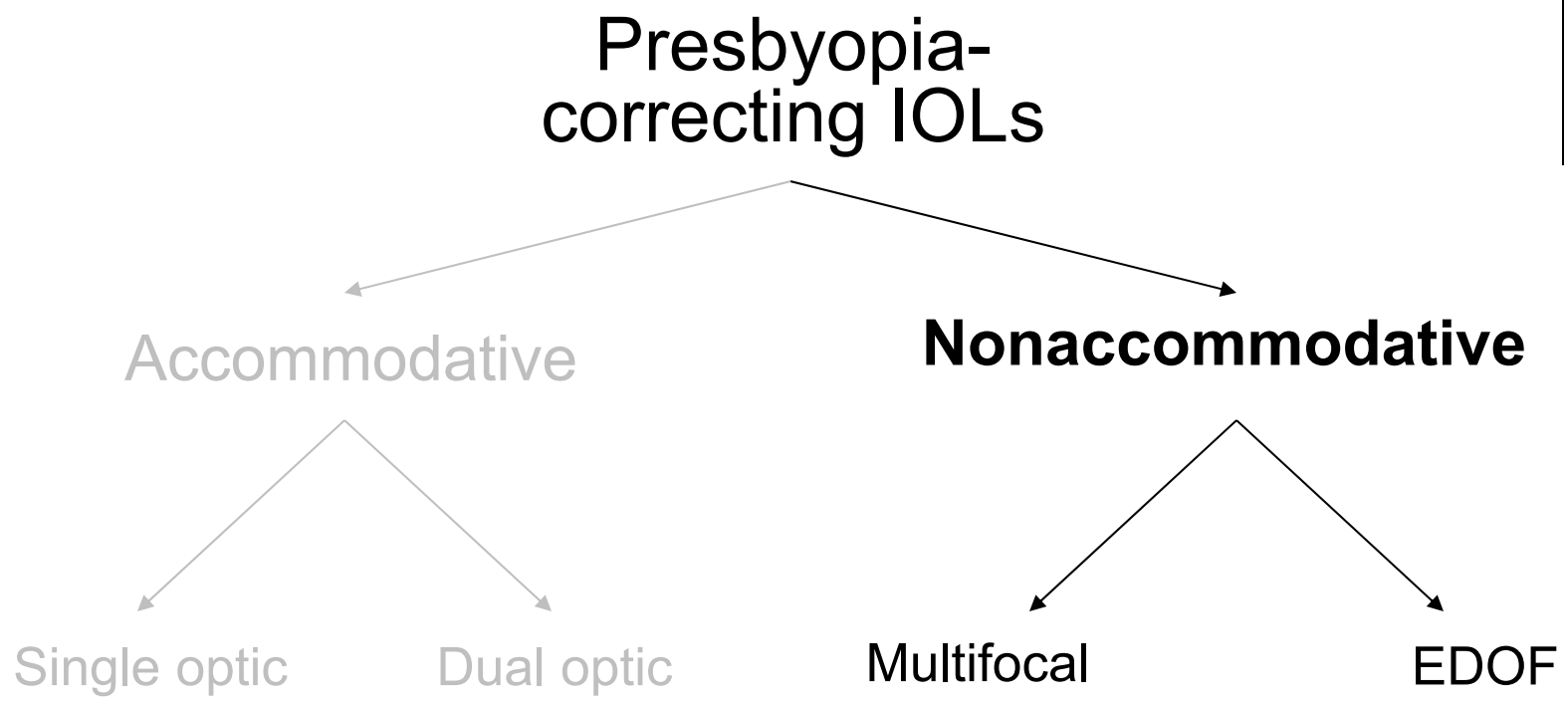
Ignore them, hopefully (in fact, a minority of pts find they cannot disregard the other images, and thus are deeply dissatisfied with their nonaccommodative IOL experience)





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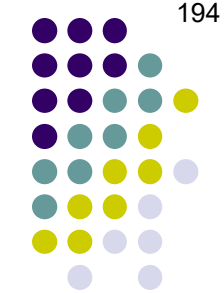

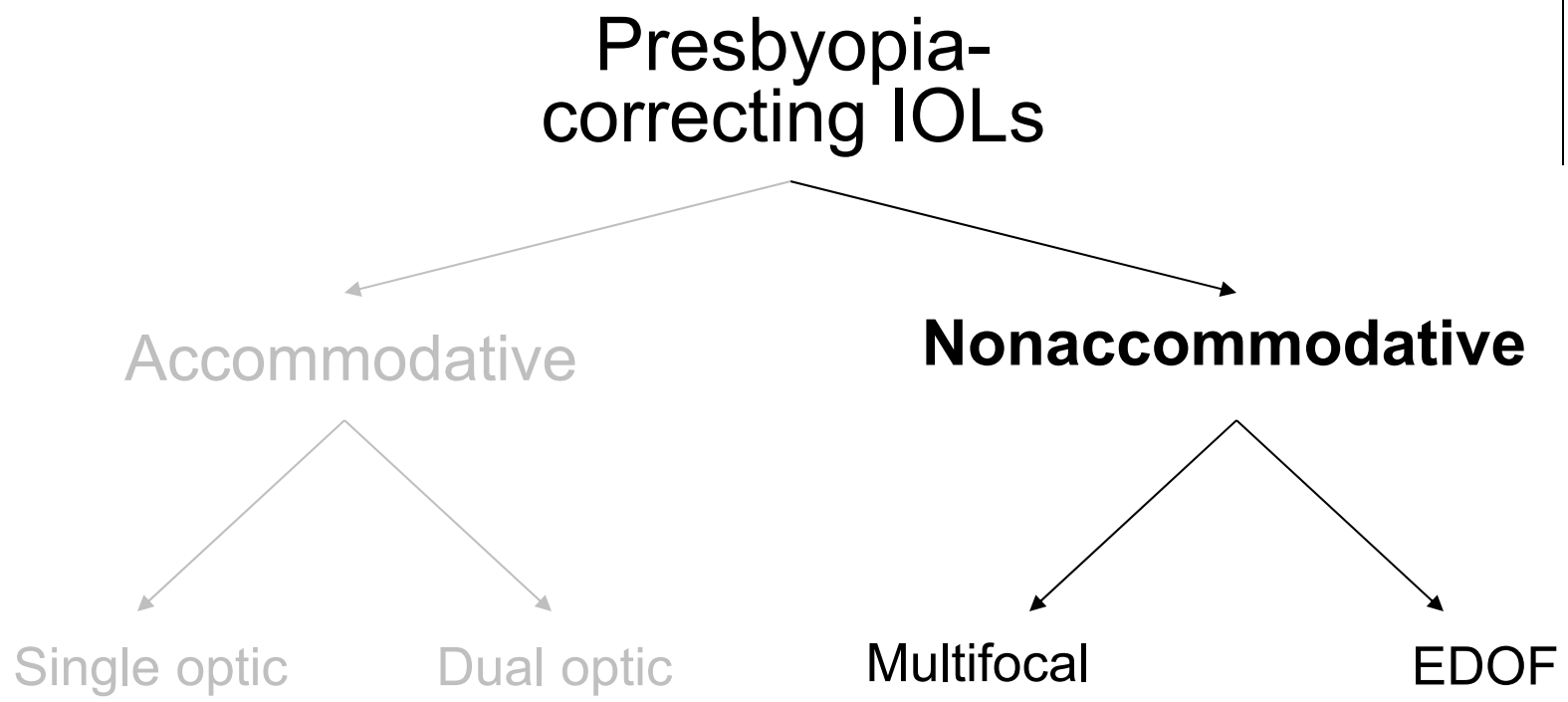

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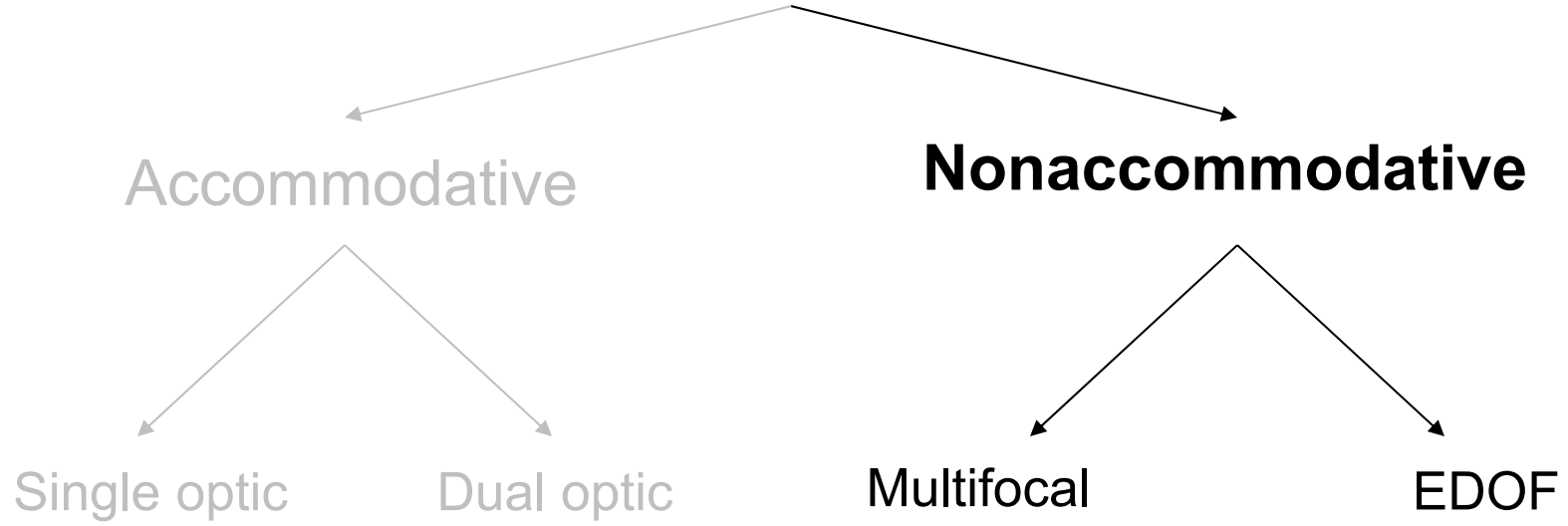
Presbyopia-correcting IOLs



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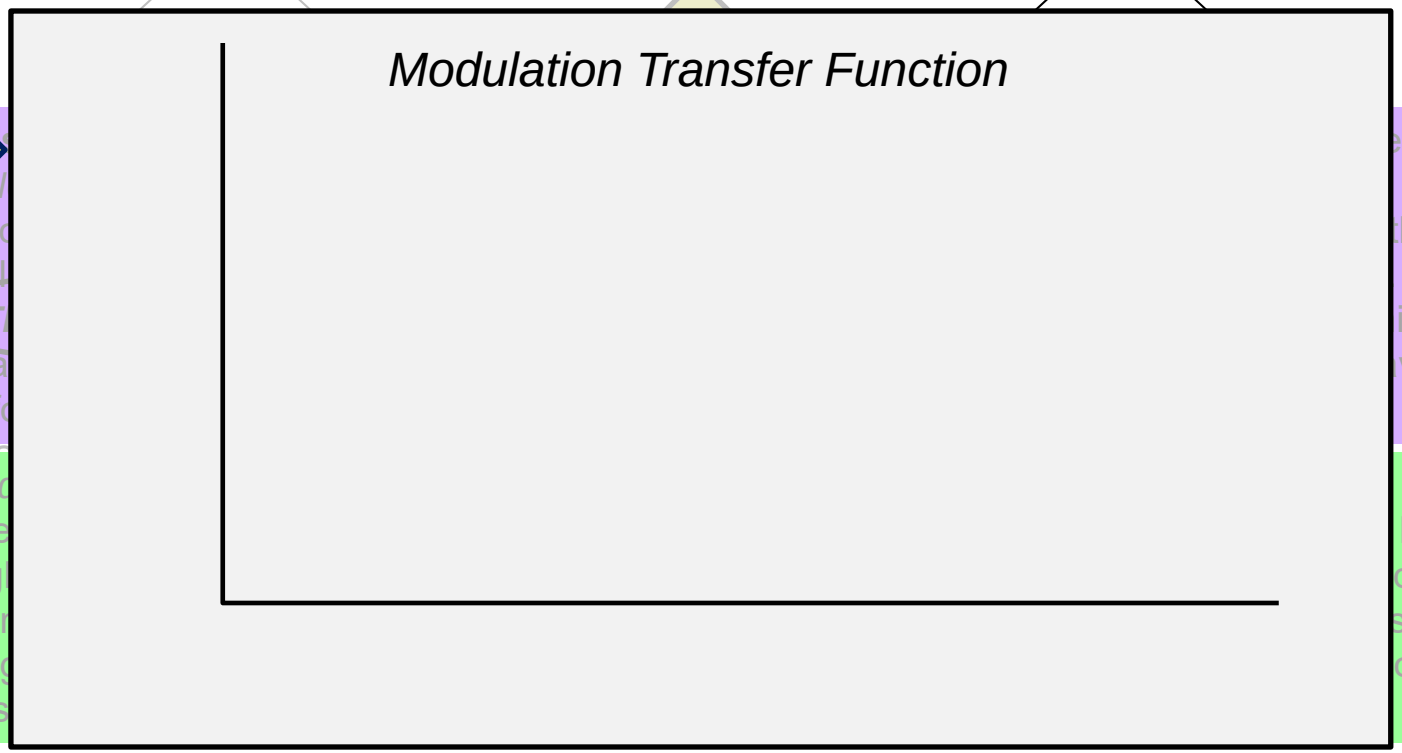

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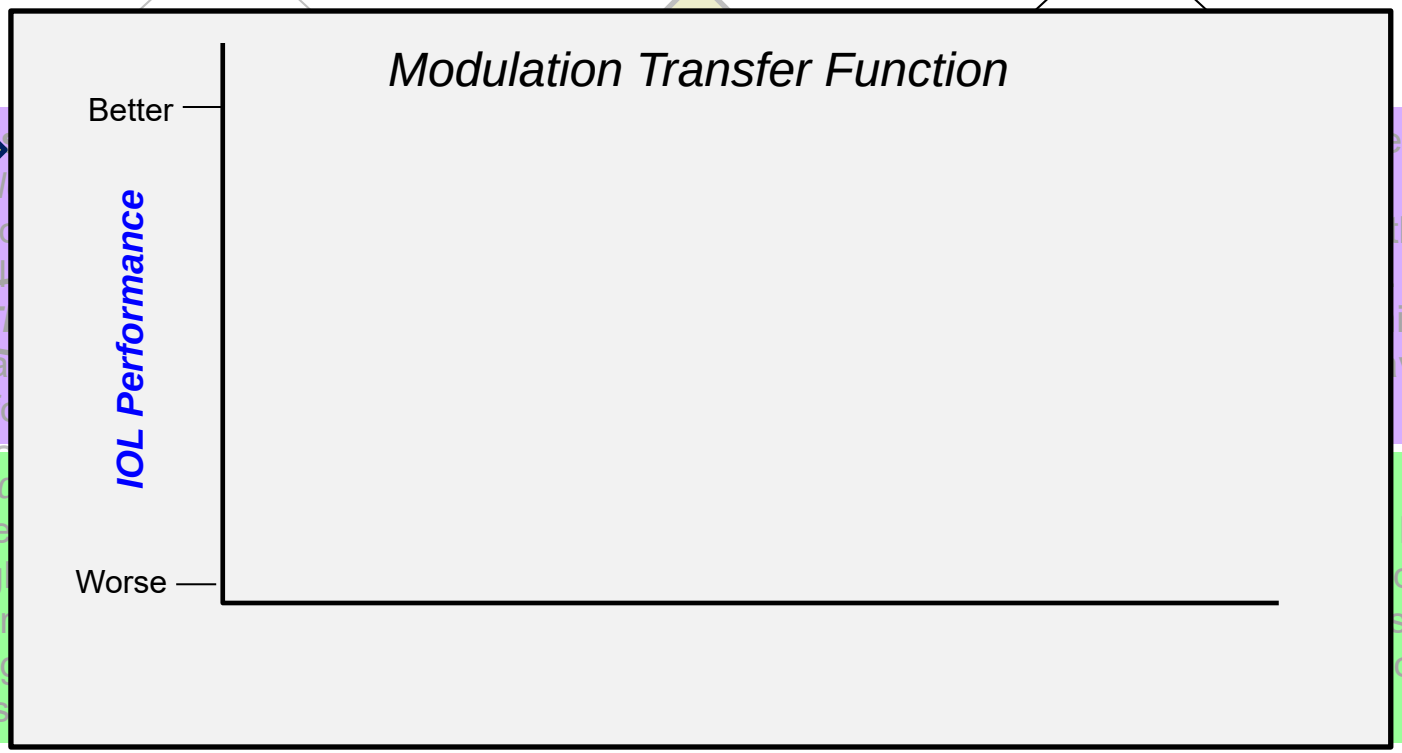

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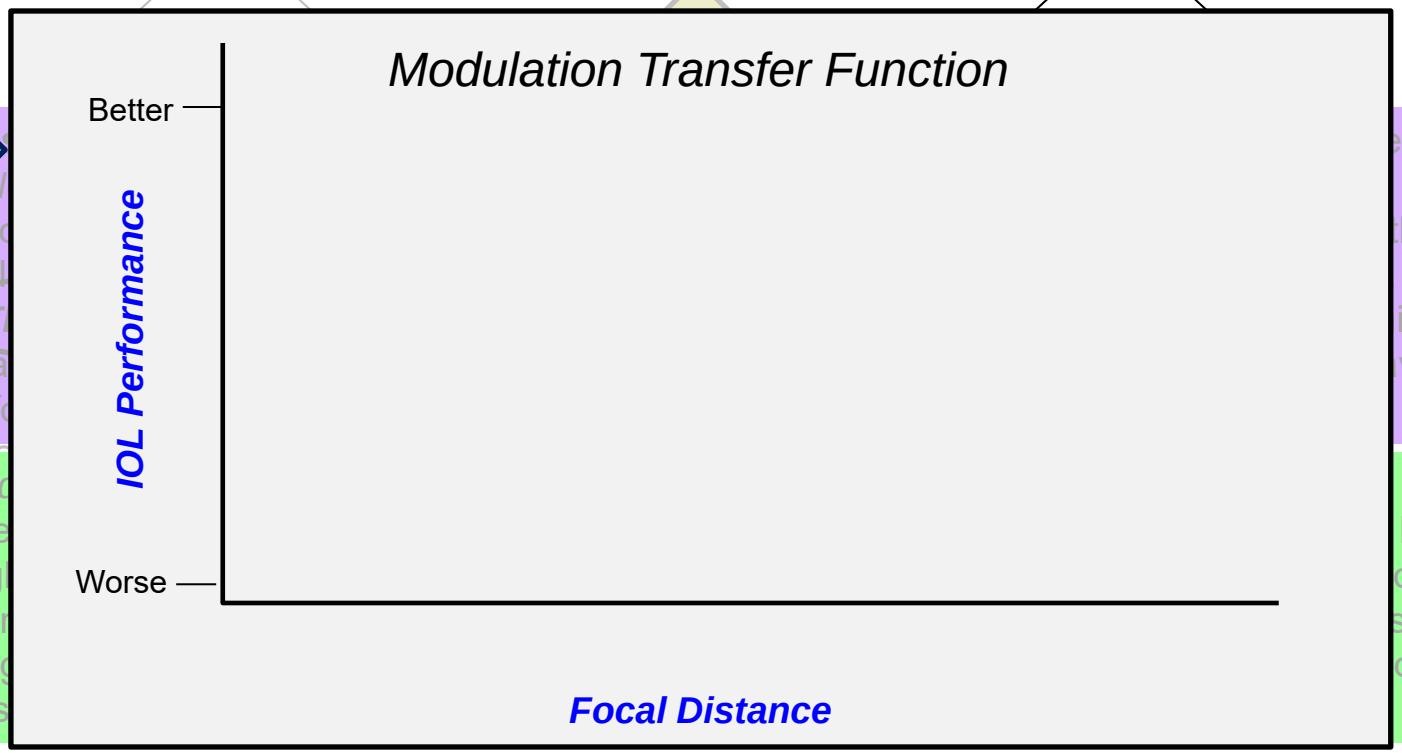

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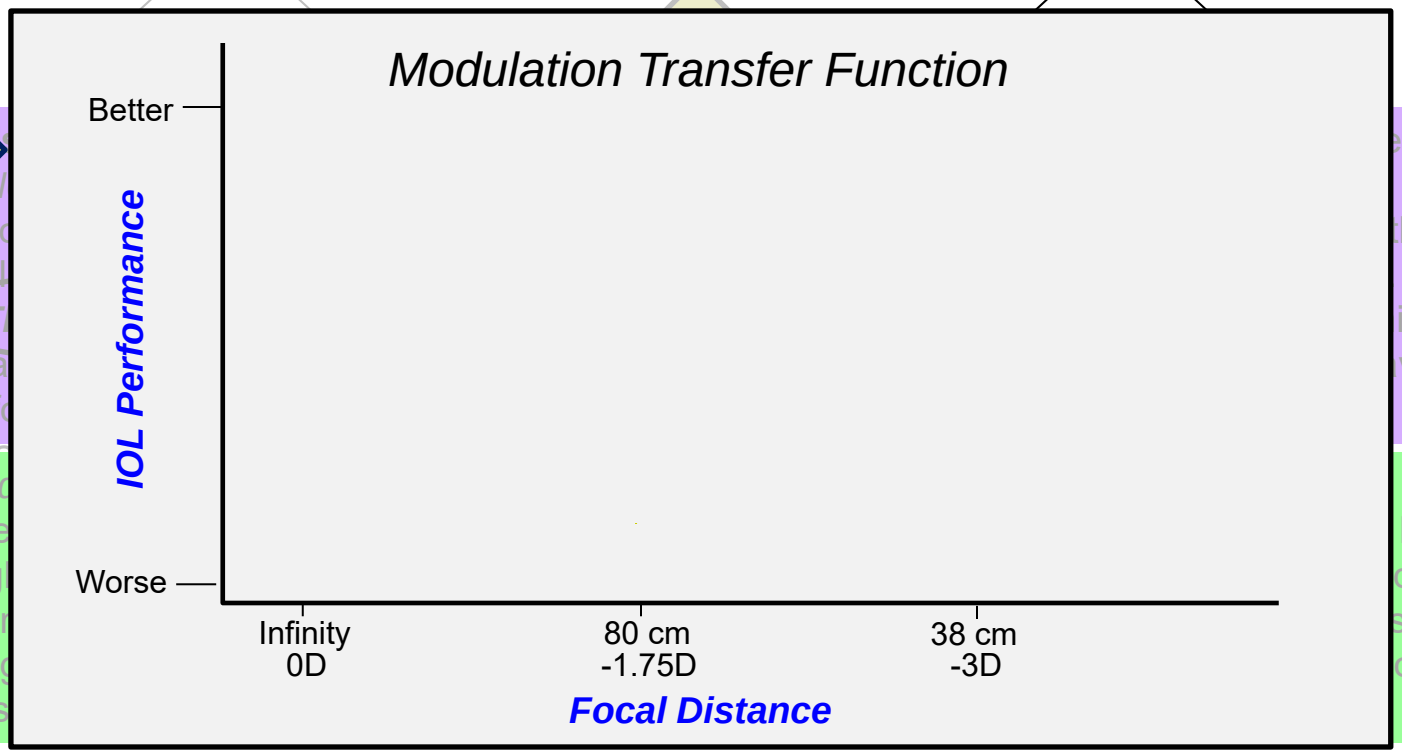

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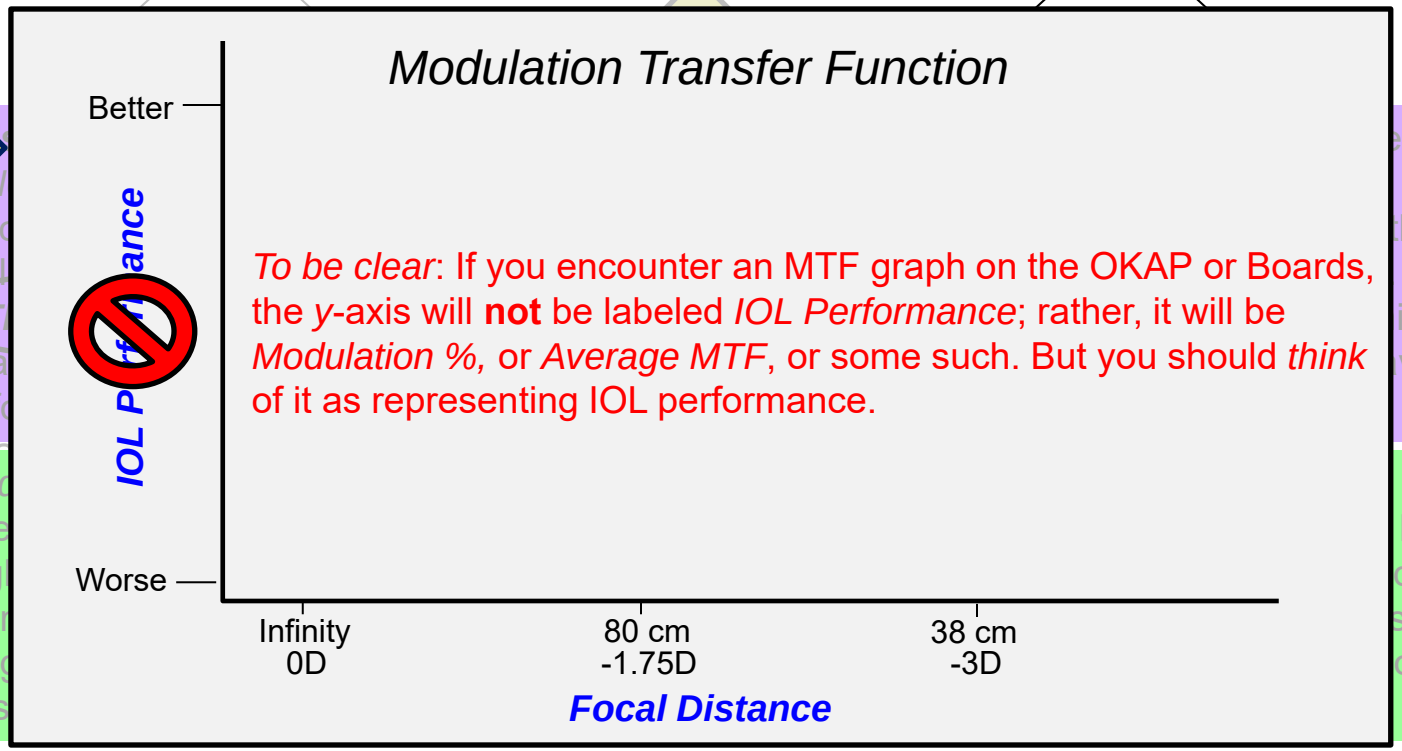

To be clear: If you encounter an MTF graph on the OKAP or Boards, the *y*-axis will **not** be labeled *IOL Performance*; rather, it will be *Modulation %,* or *Average MTF*, or some such. But you should *think* of it as representing IOL performance.

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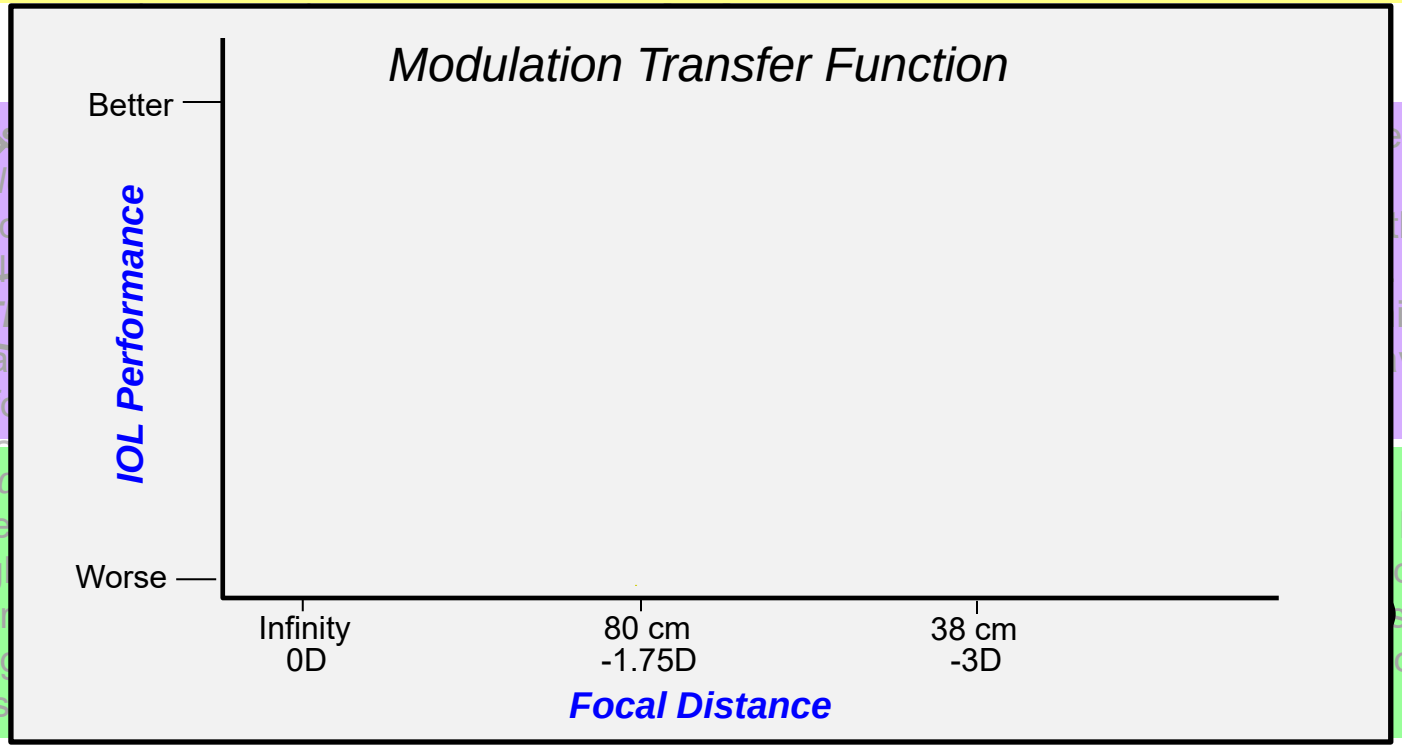

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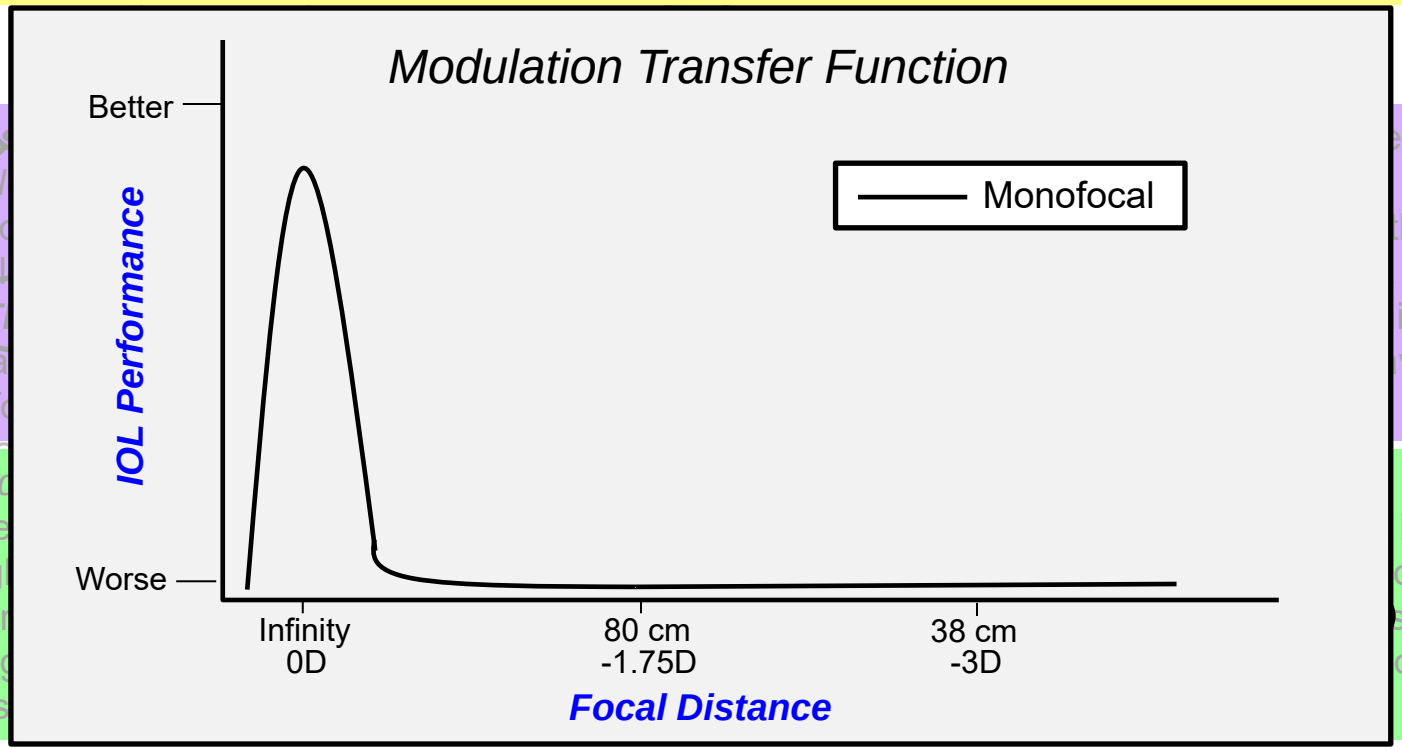

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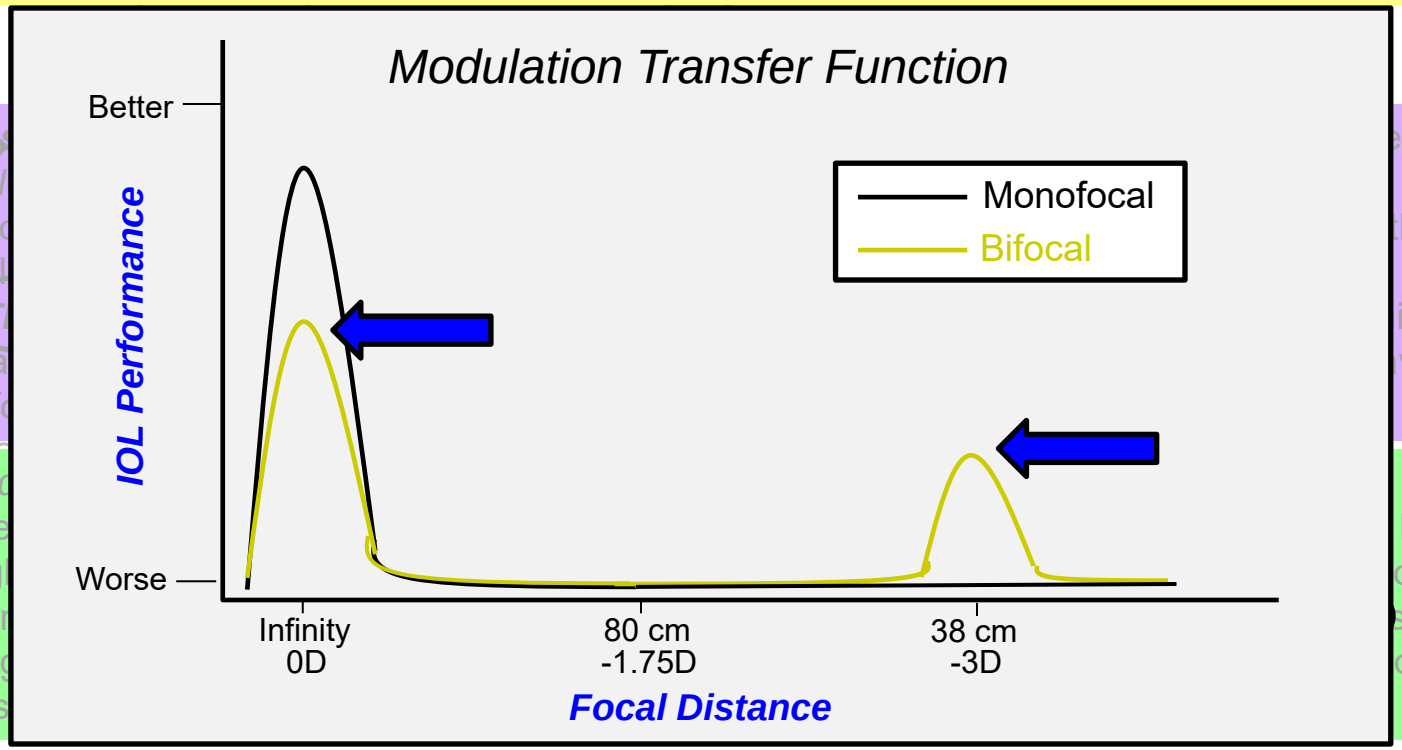

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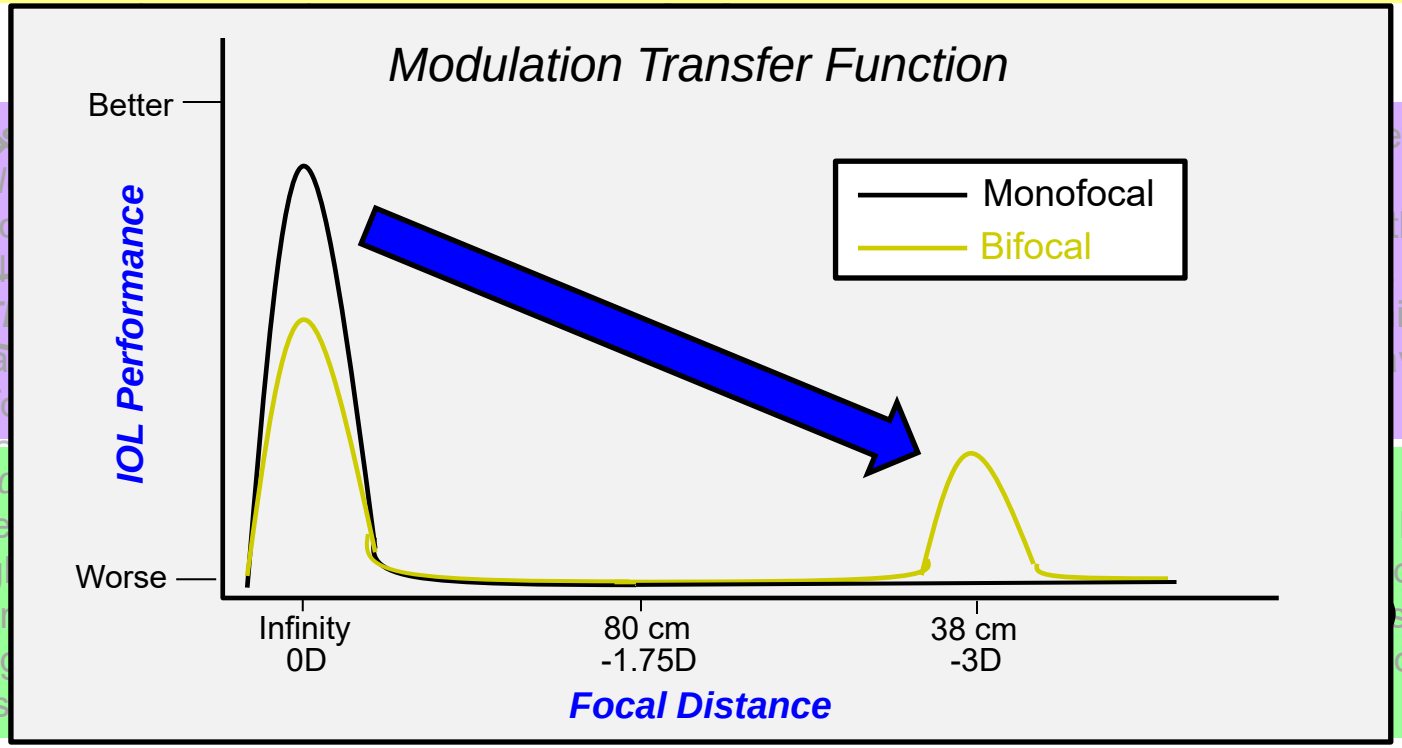

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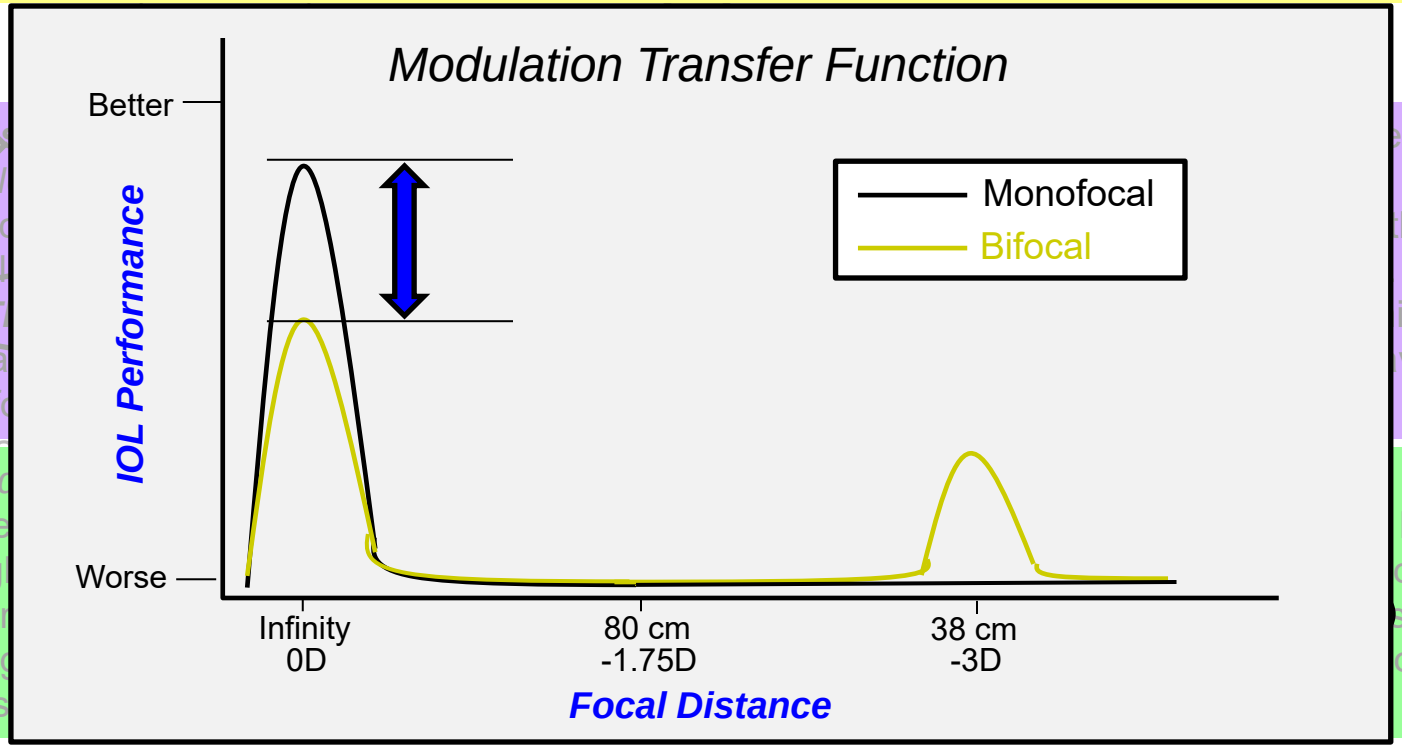

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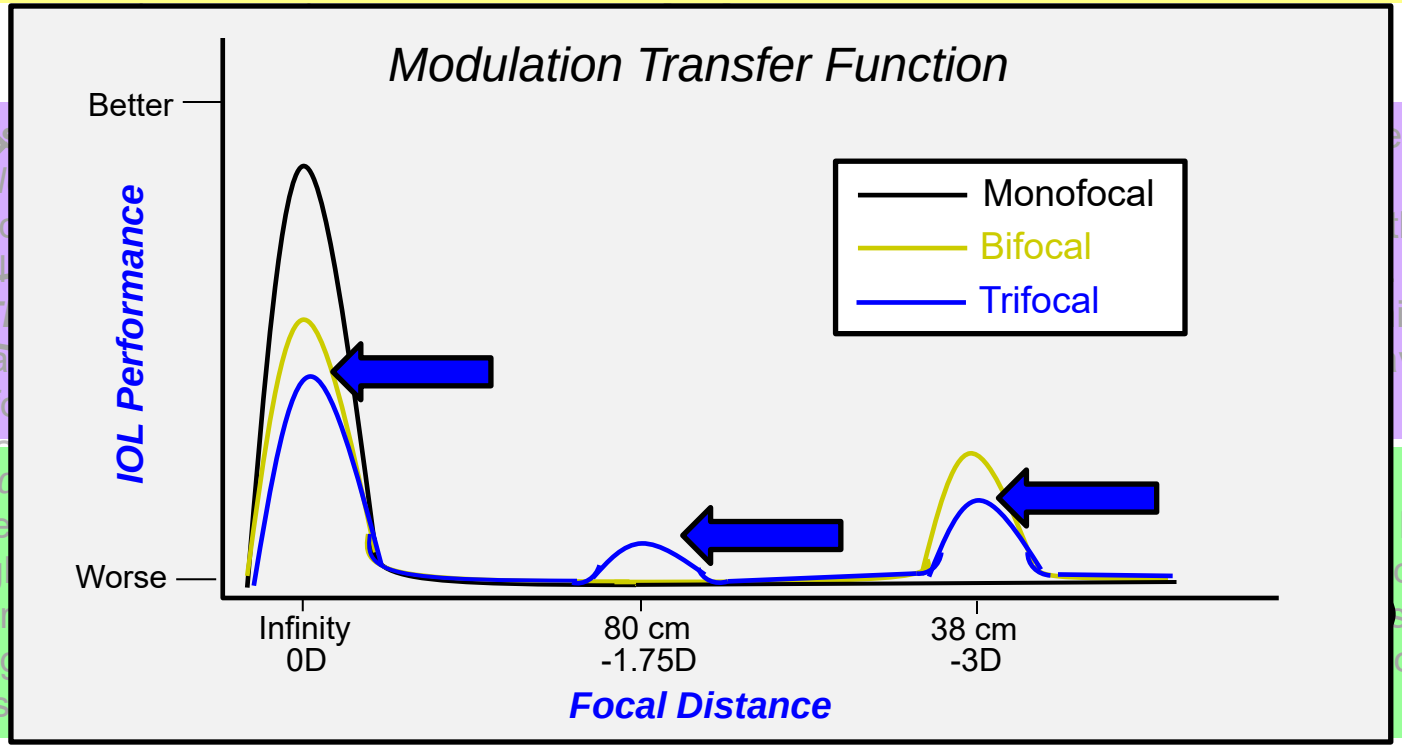

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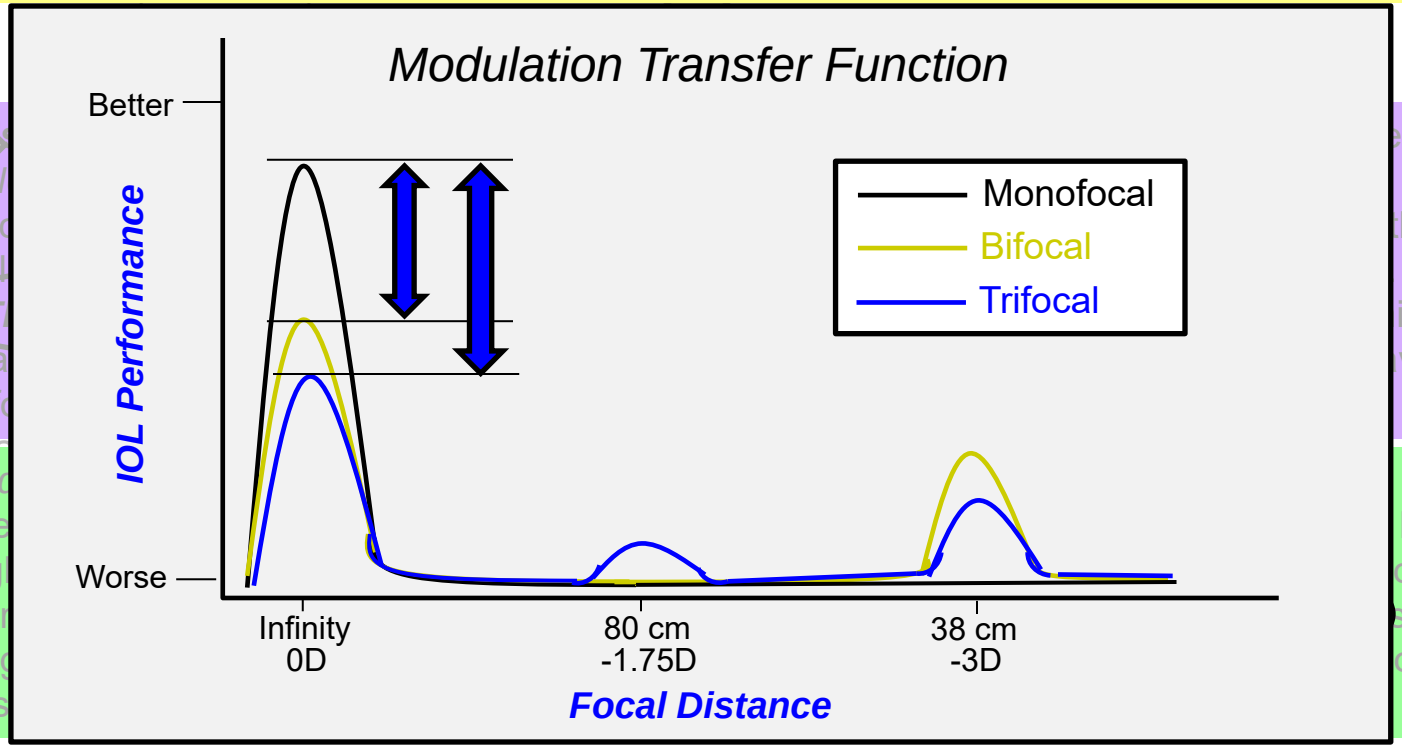

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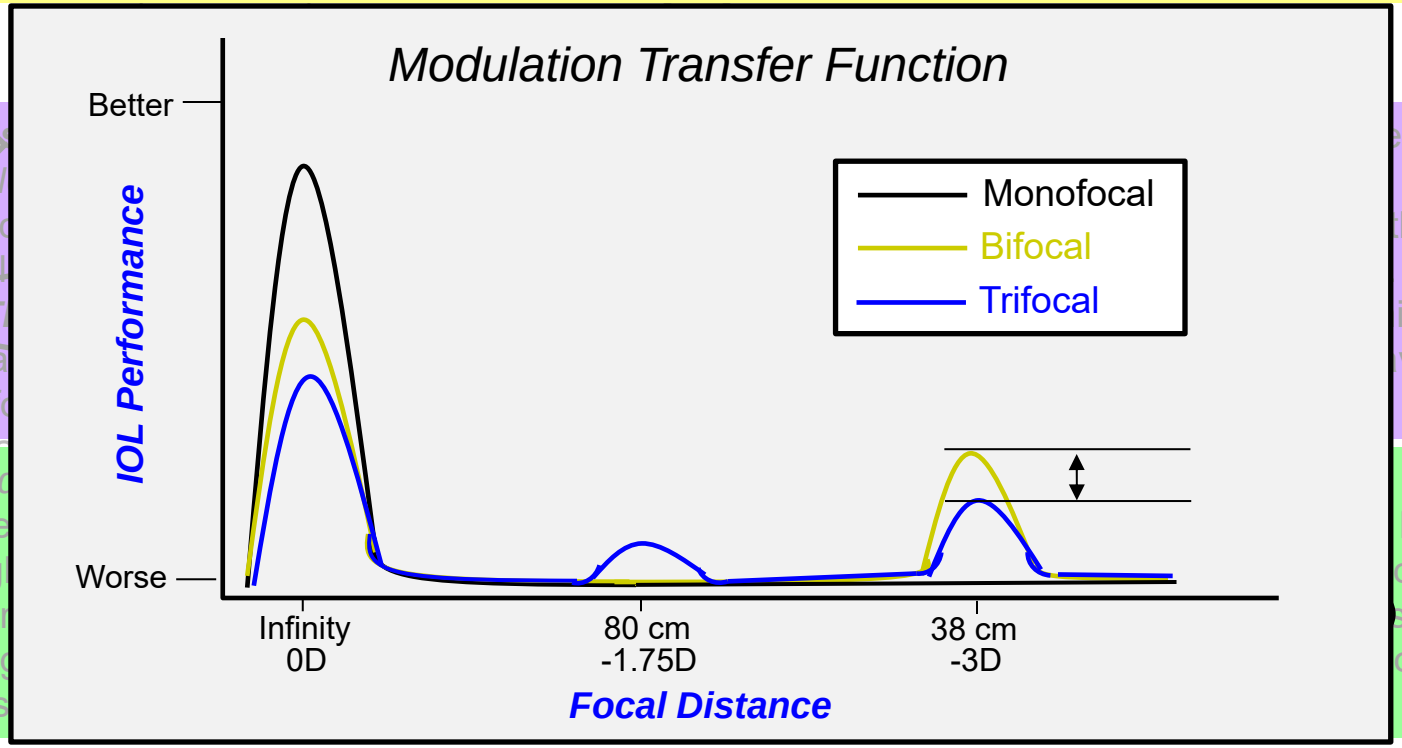

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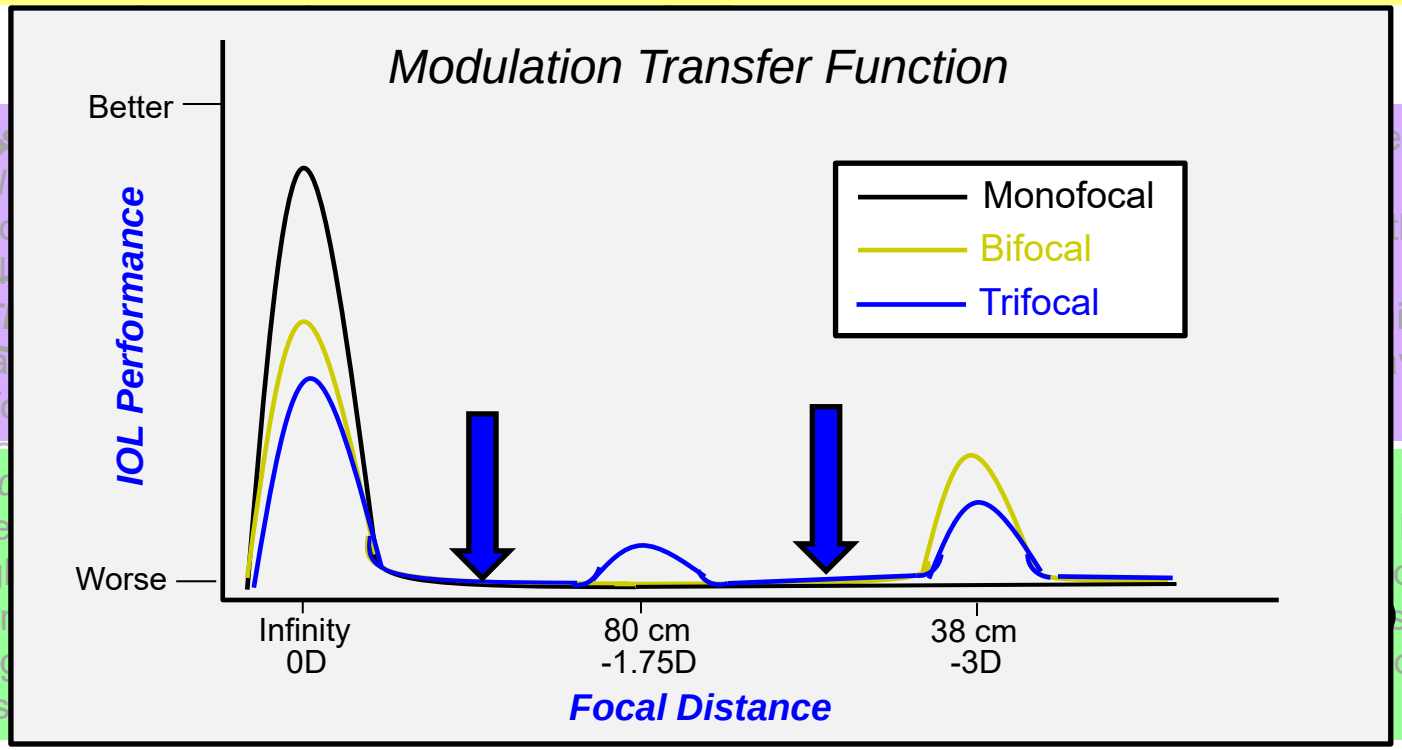
--For all three IOL designs, the MTF drops to near zero between peaks, indicating that vision at these 'in-between distances' is poor.



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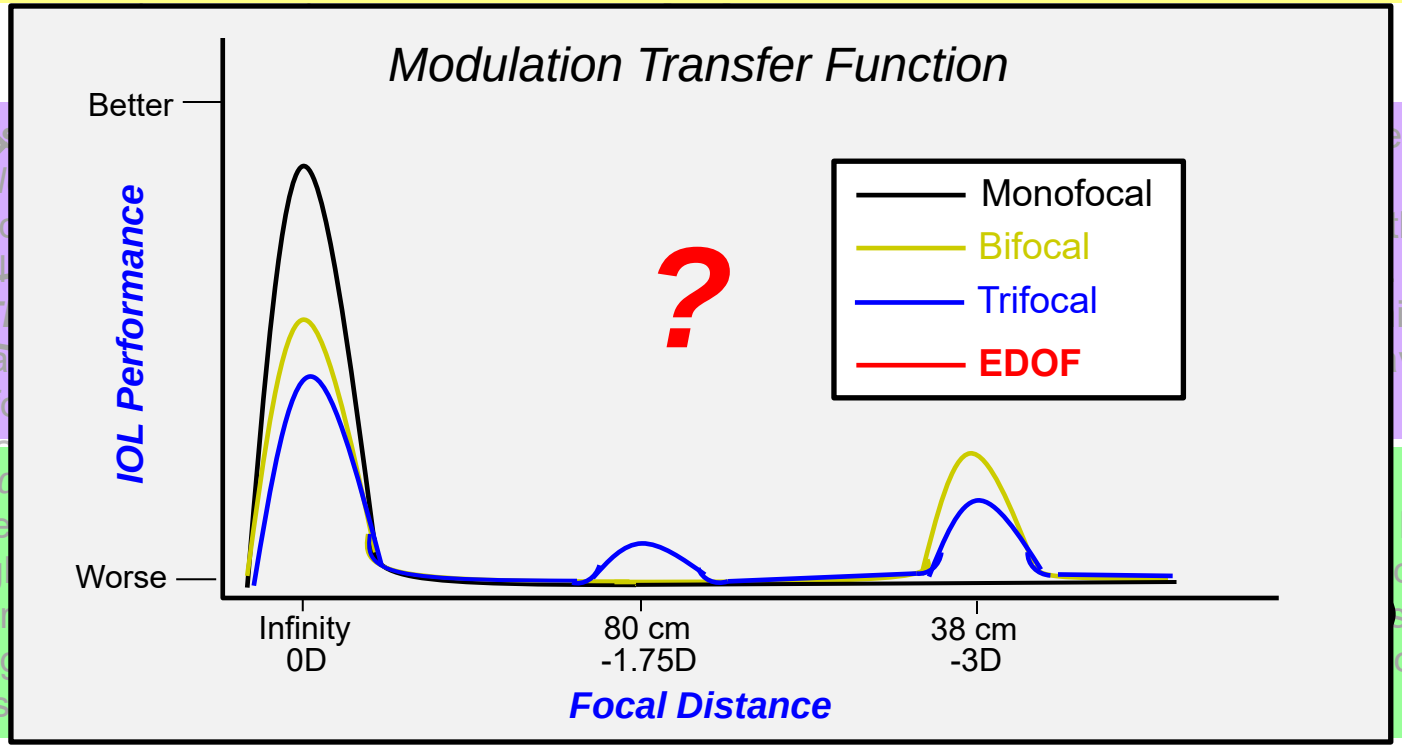

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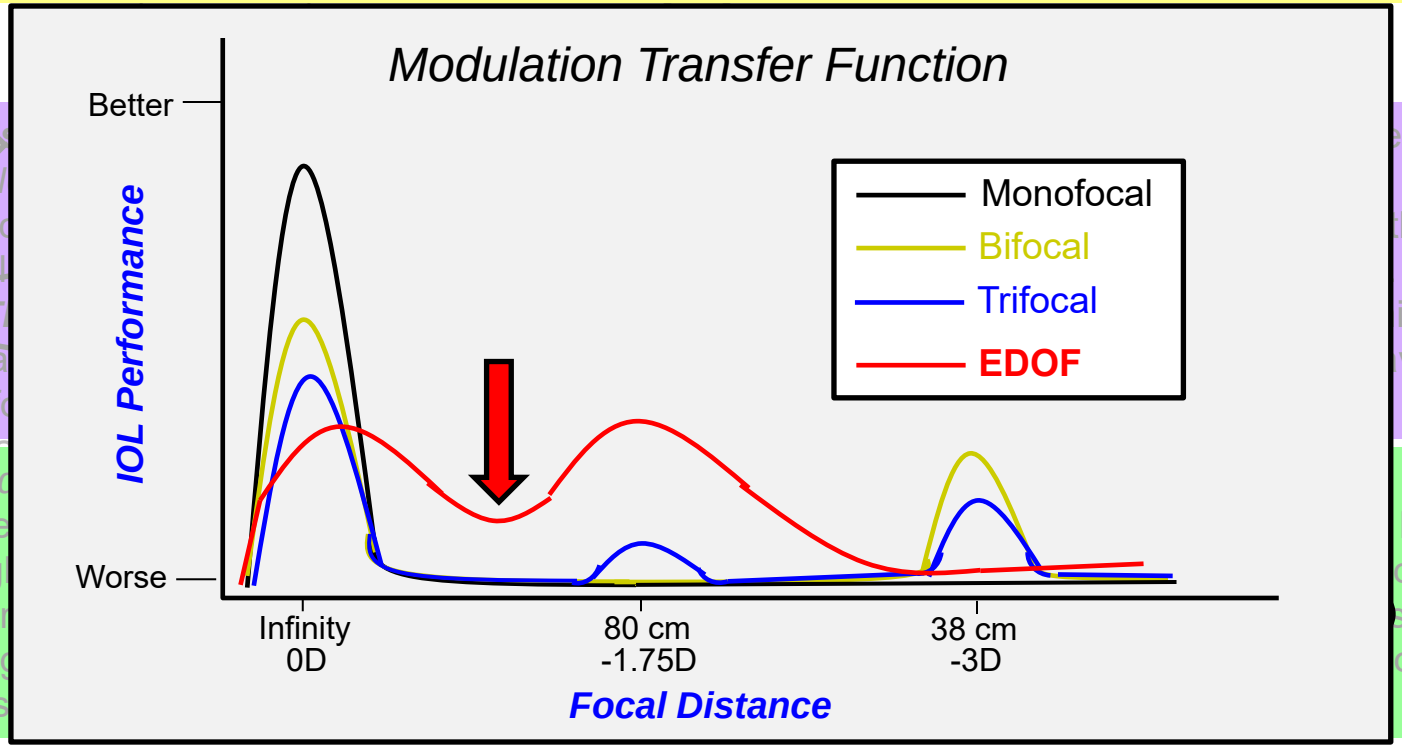
--Most notably (in the opinion of the *Optics* book) is the fact that EDOF curves do **not** fall off precipitously between their distance and intermediate peaks as do multifocal IOLs.



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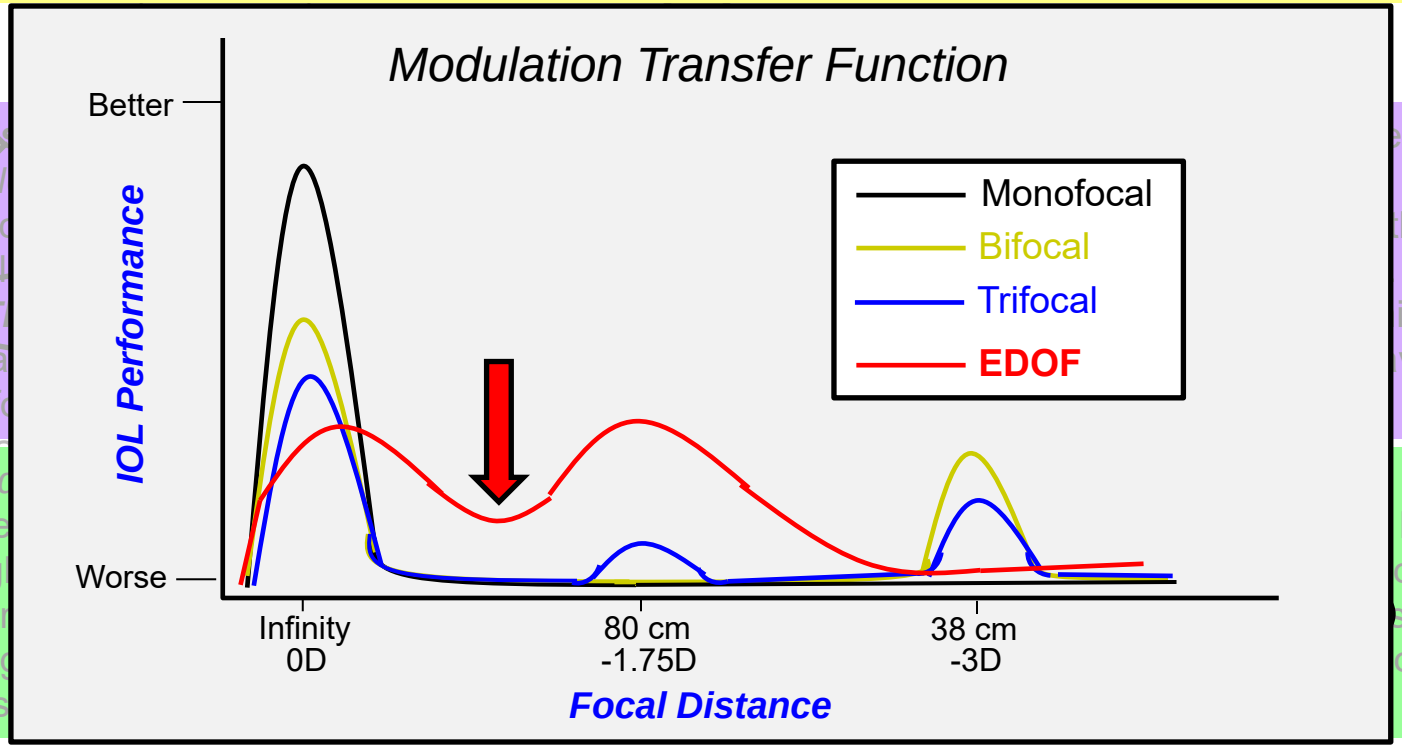

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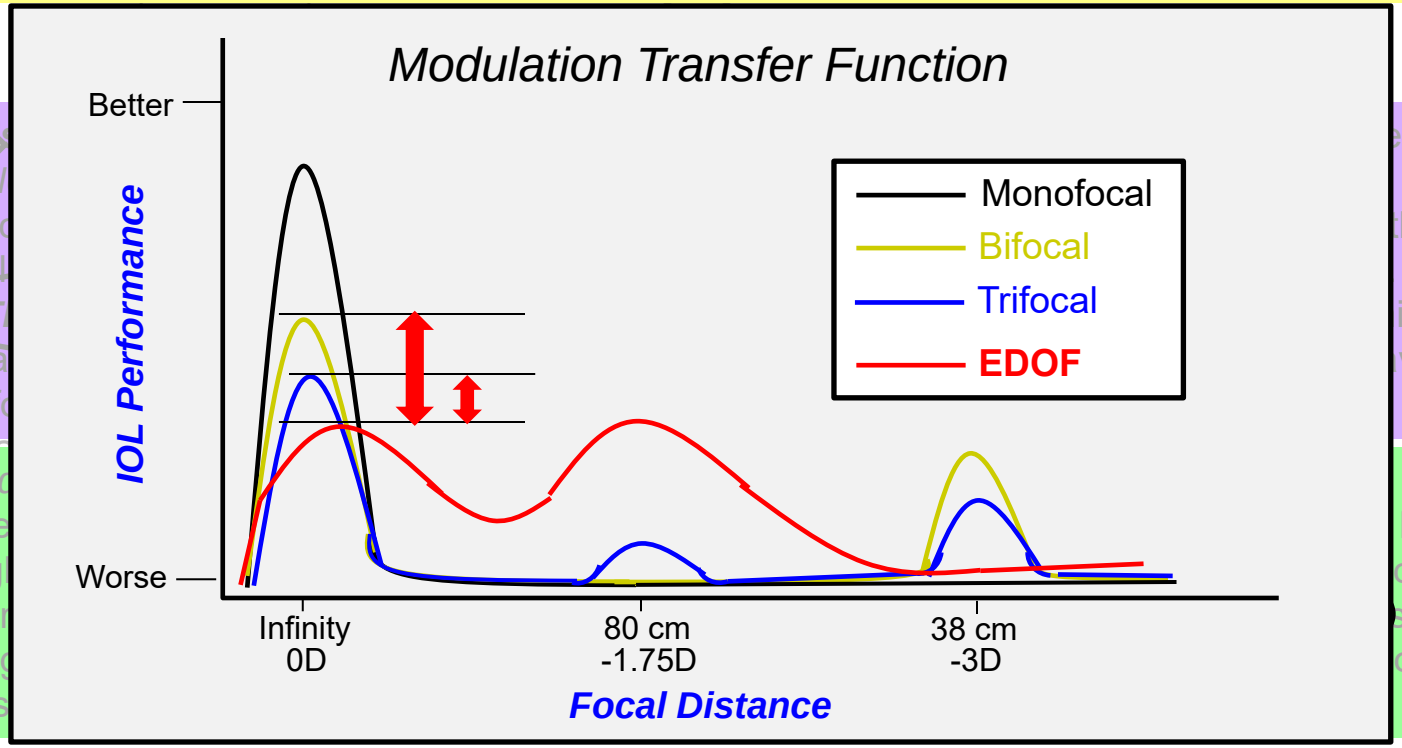
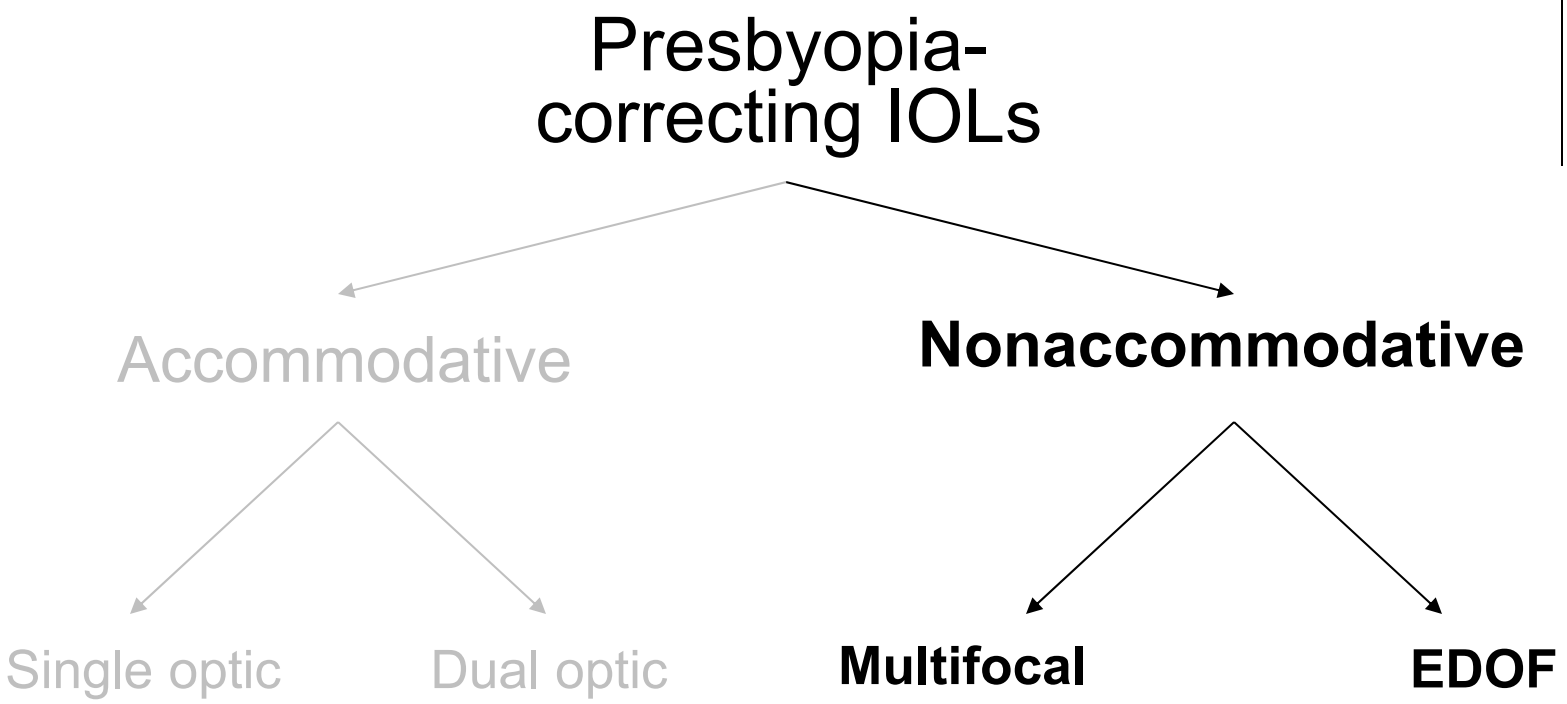
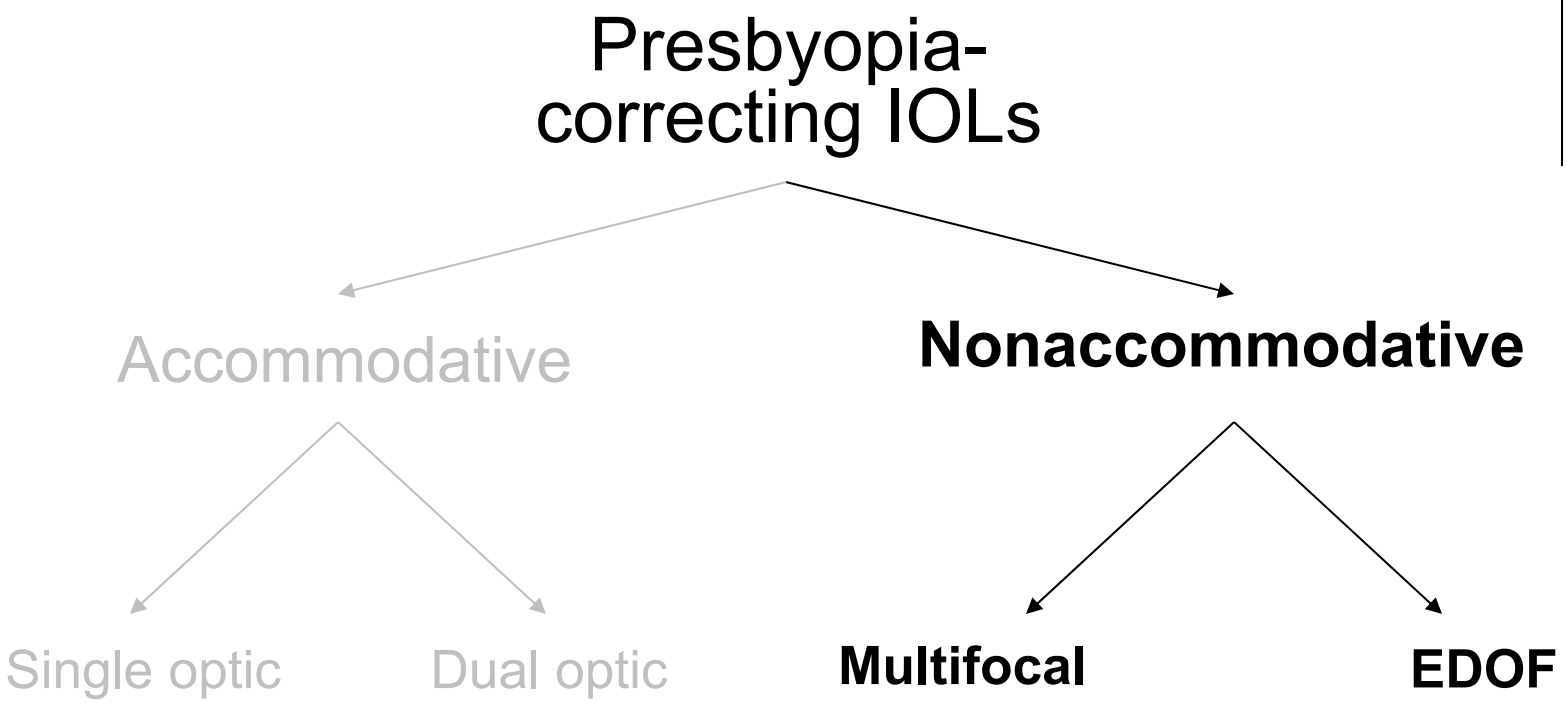
--But, because of the zero-sum nature of IOL light transmission, this superior in-between vision comes at the cost of vision at the 'peak' distances when compared to multifocal IOLs.





Two optical principles do most of the work in nonaccommodative IOL platforms available in the US. What are these principles?



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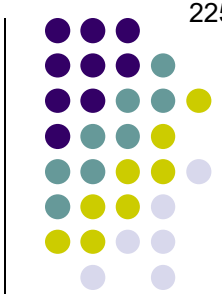
Refraction and **diffraction**



Presbyopia-correcting IOLs

- Accommodative
  - Single optic
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- **Nonaccommodative**
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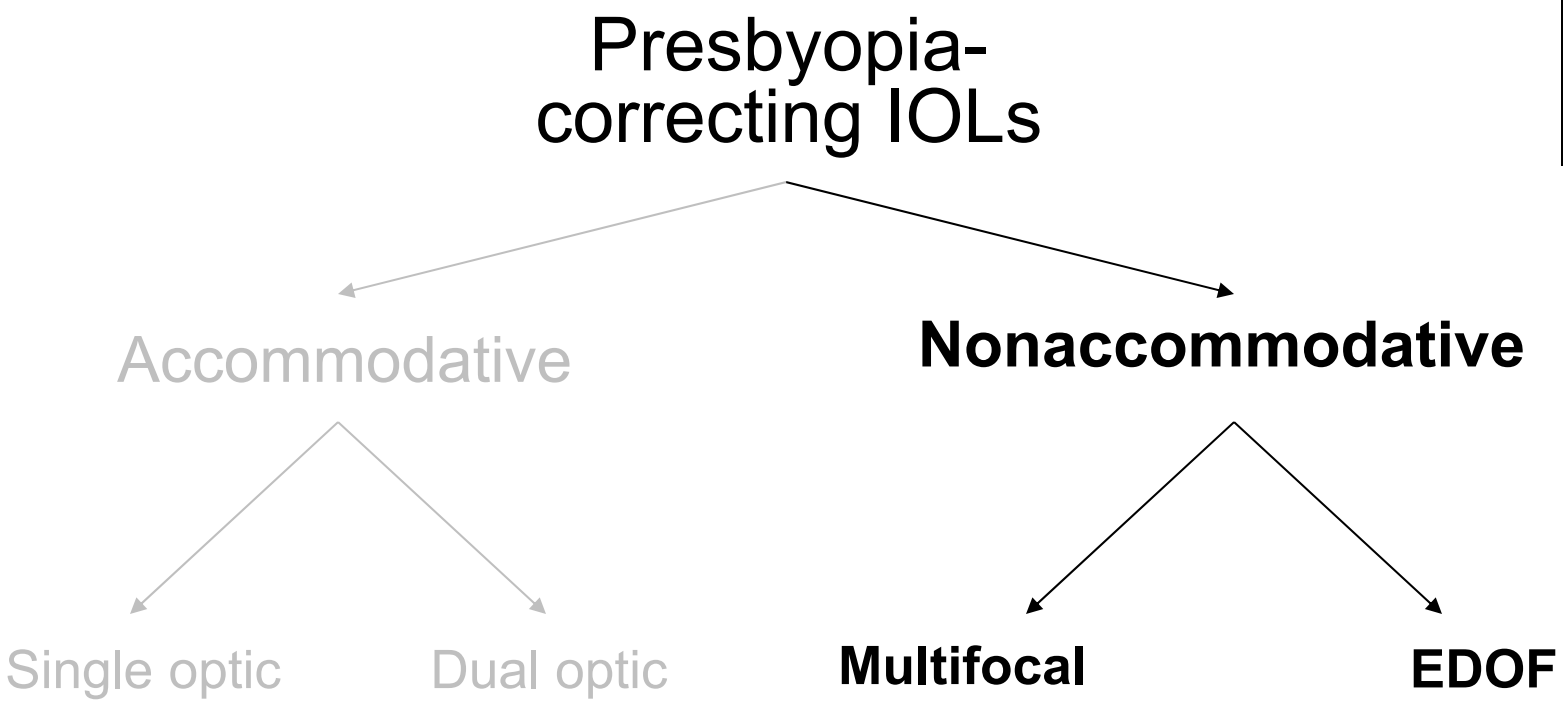
Some multifocals employ refractive optics exclusively. How are they set up?



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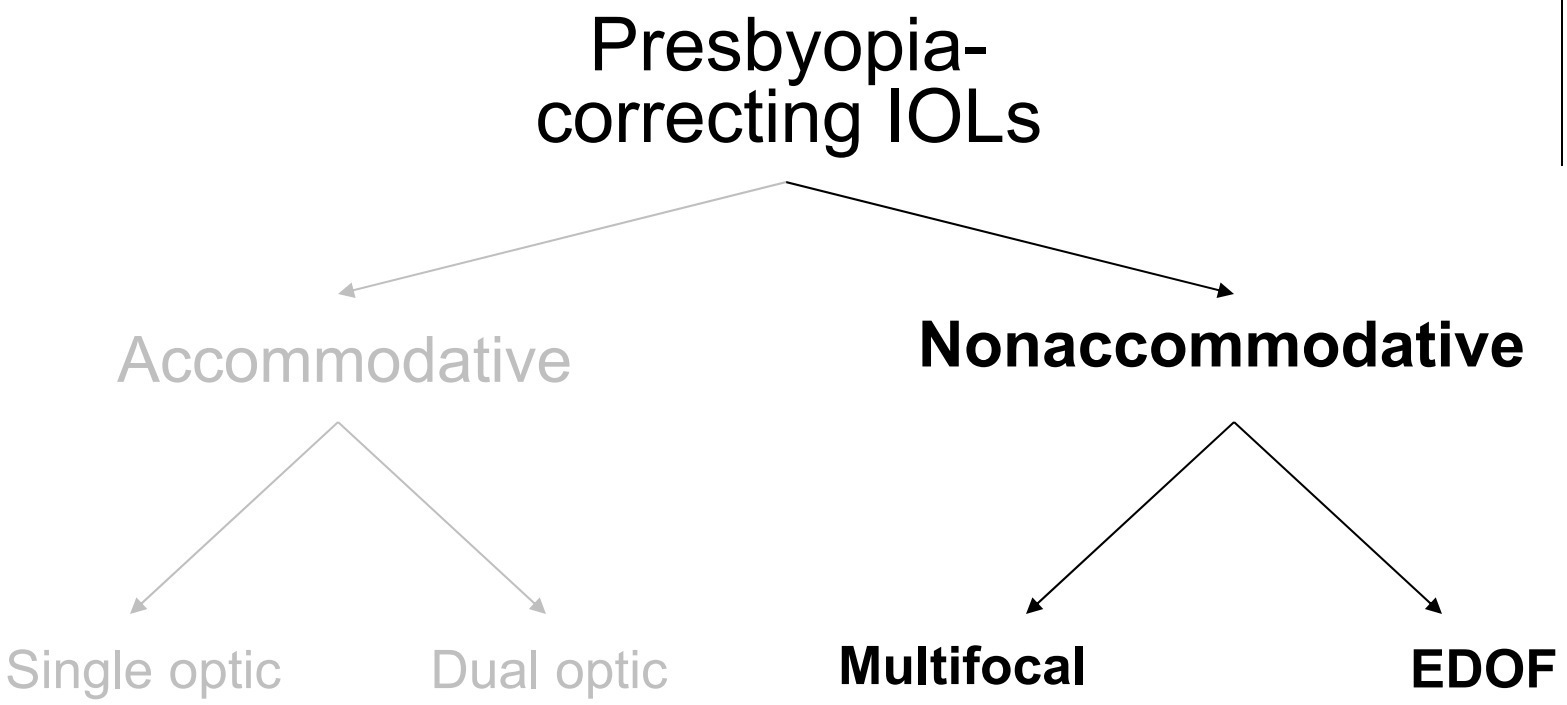
Most consist of multiple discrete refractive rings, with one (or more) rings powered for distance, and likewise for near. Which image-distance is dominant depends upon pupil size and lighting conditions.



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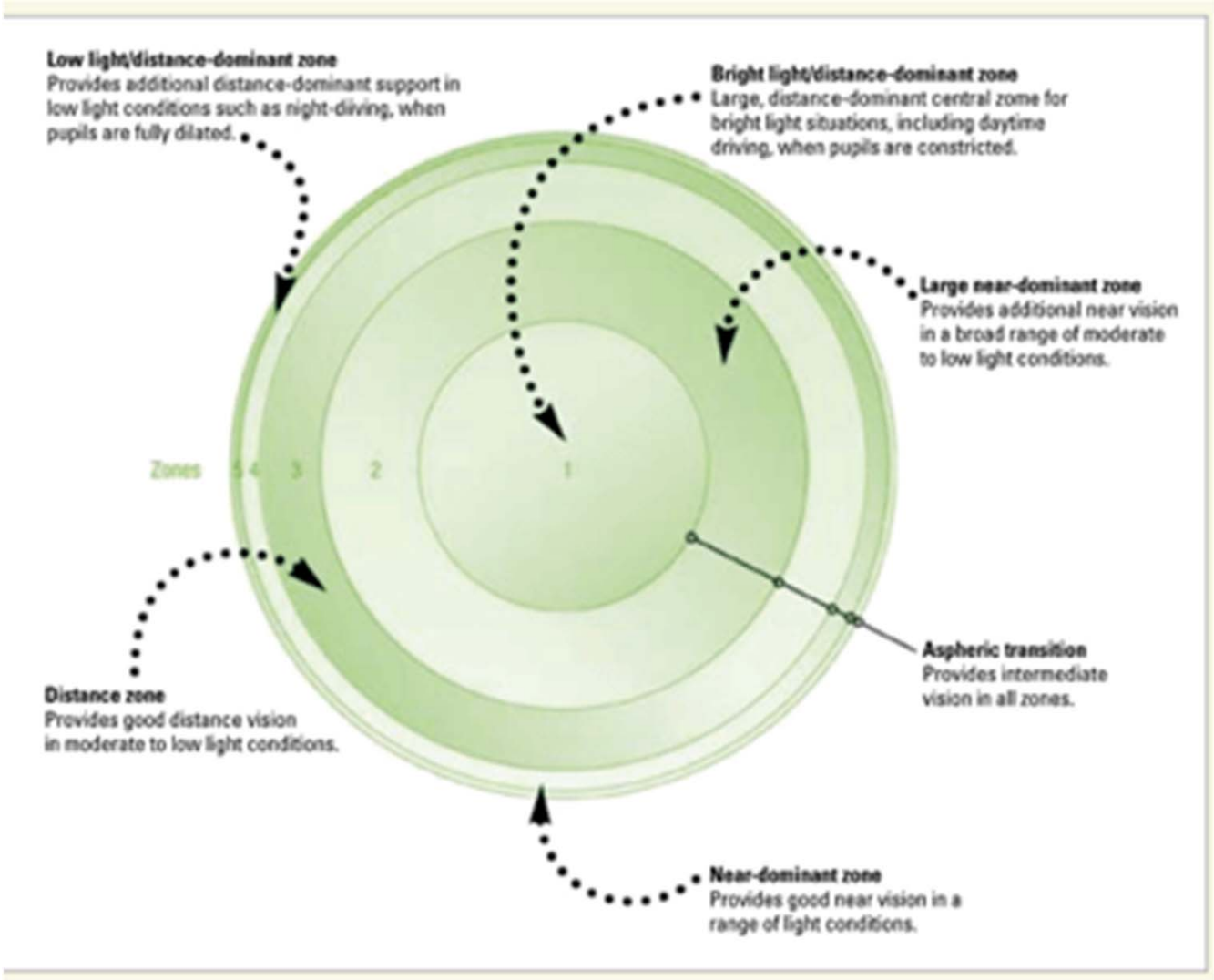
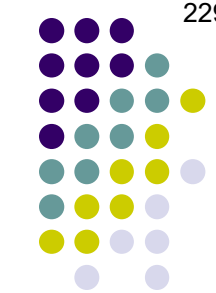
Other versions use multiple rings that each acts as its own progressive lens, ie, each is powered for distance, but contains a progressive 'add' of 3.5D. The advantage of this ***annular zone*** approach is that, no matter what the size of the pupil, the IOL is able to provide focused images over distances ranging from infinity to near.



Refractive multifocal IOL with annular zones



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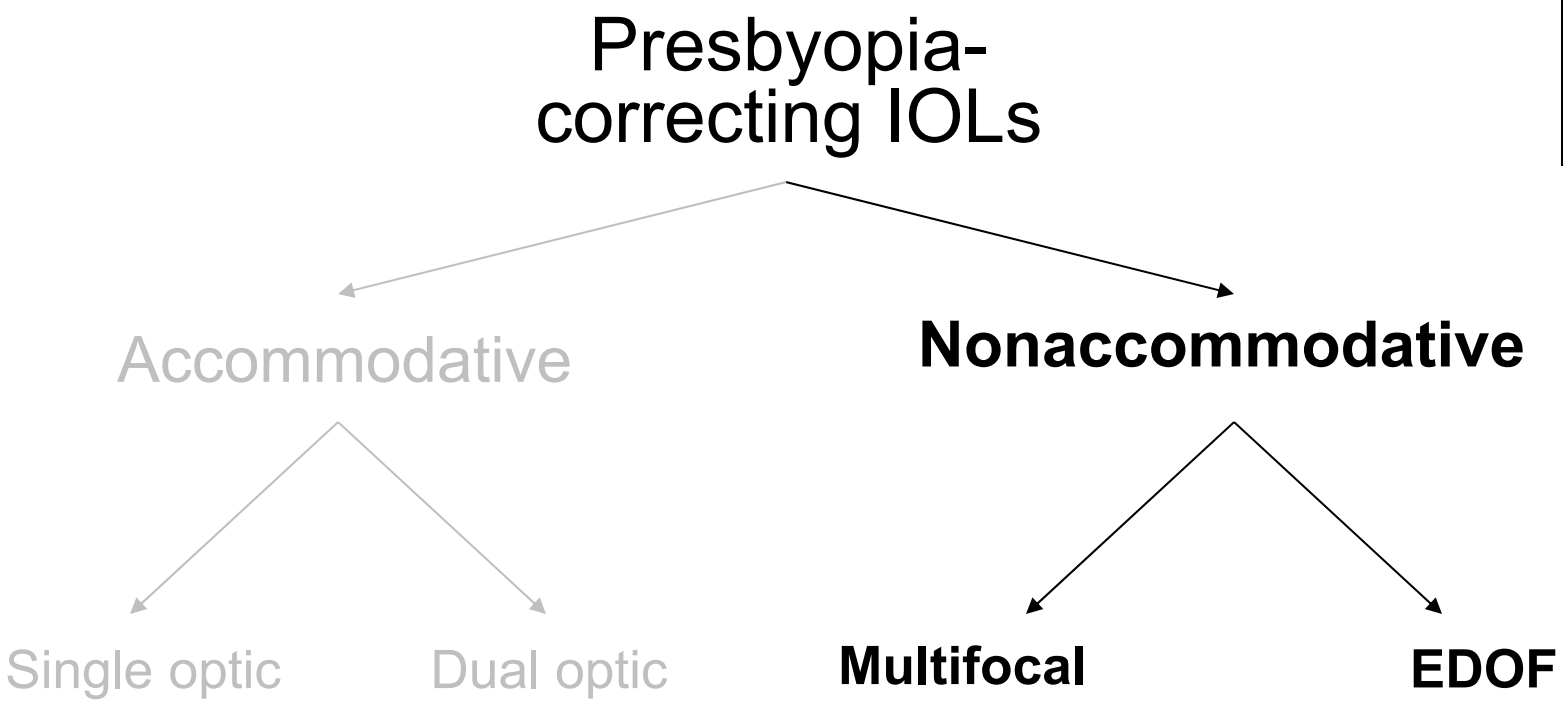
Briefly, what is diffractive optics*?*



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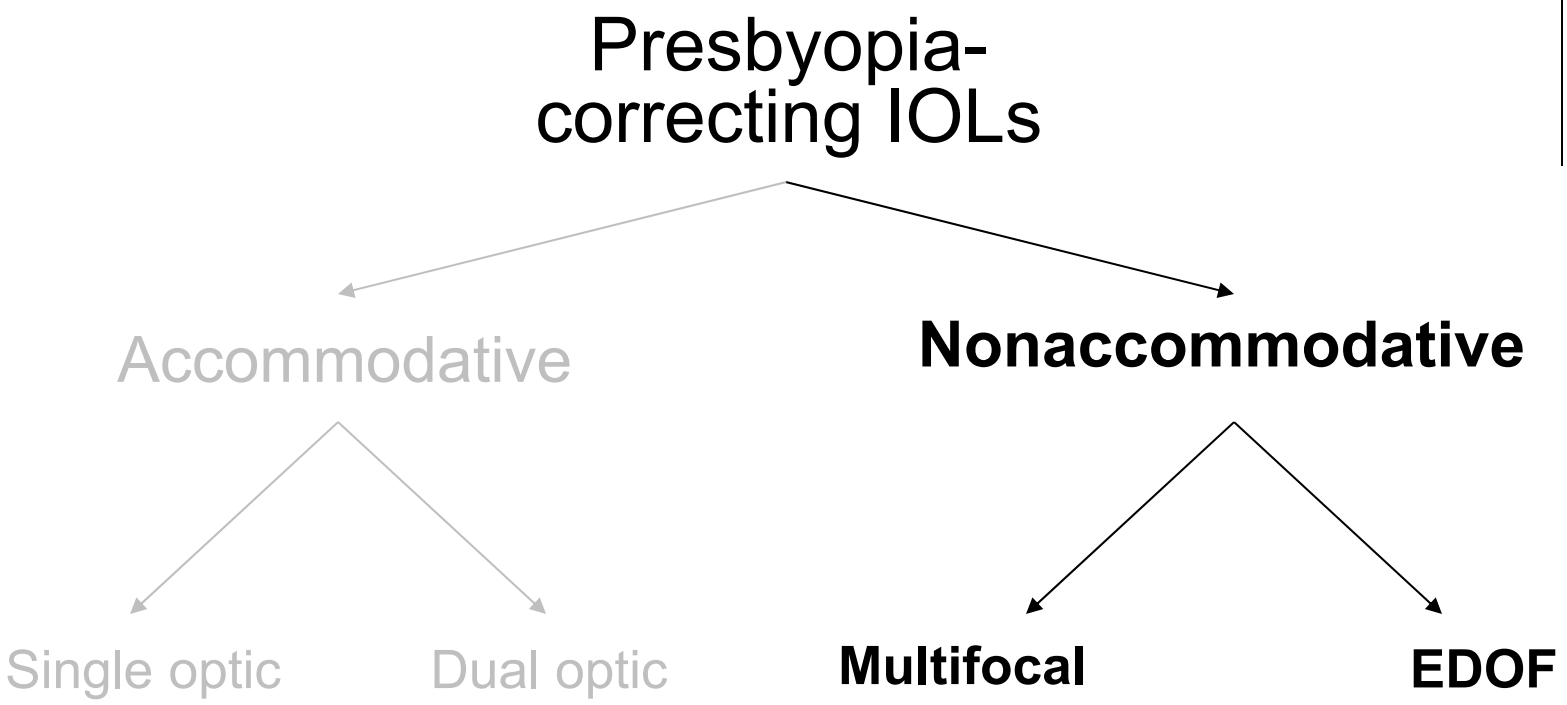
Recall that diffraction is the scattering of light that results when it passes through an aperture roughly the size of its wavelength. As these scattered light waves encounter one another, they will cancel each other out if the waves are out-of-phase, or reinforce one another if they're in-phase.



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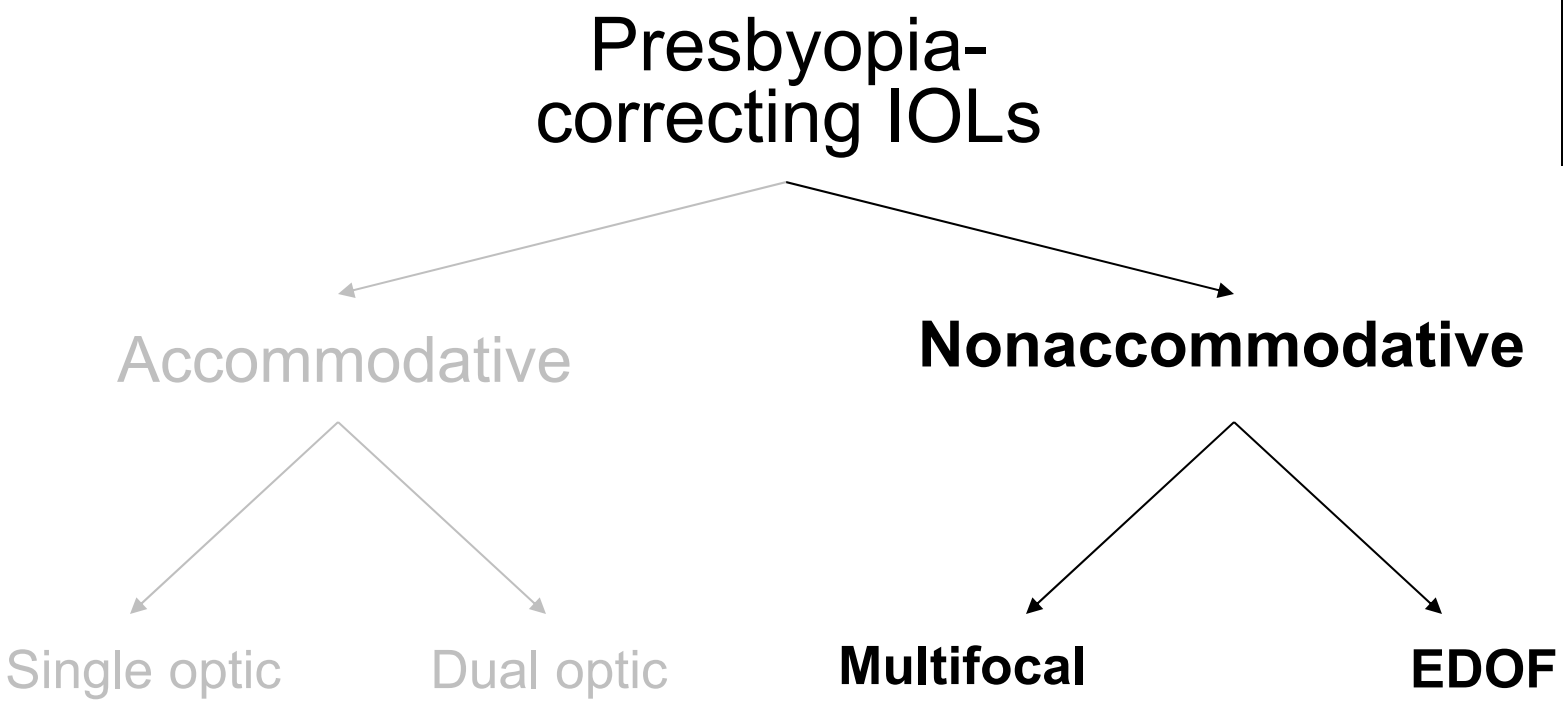

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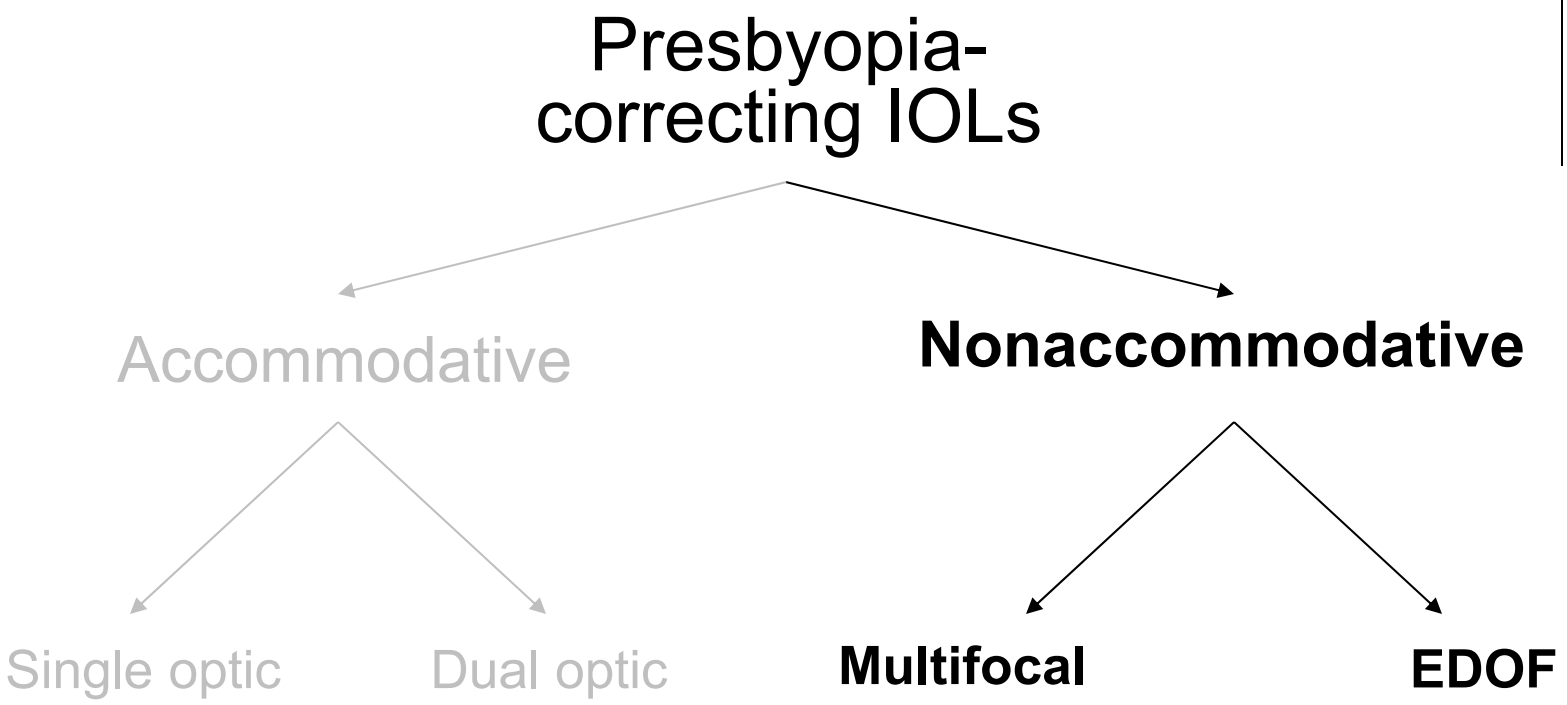
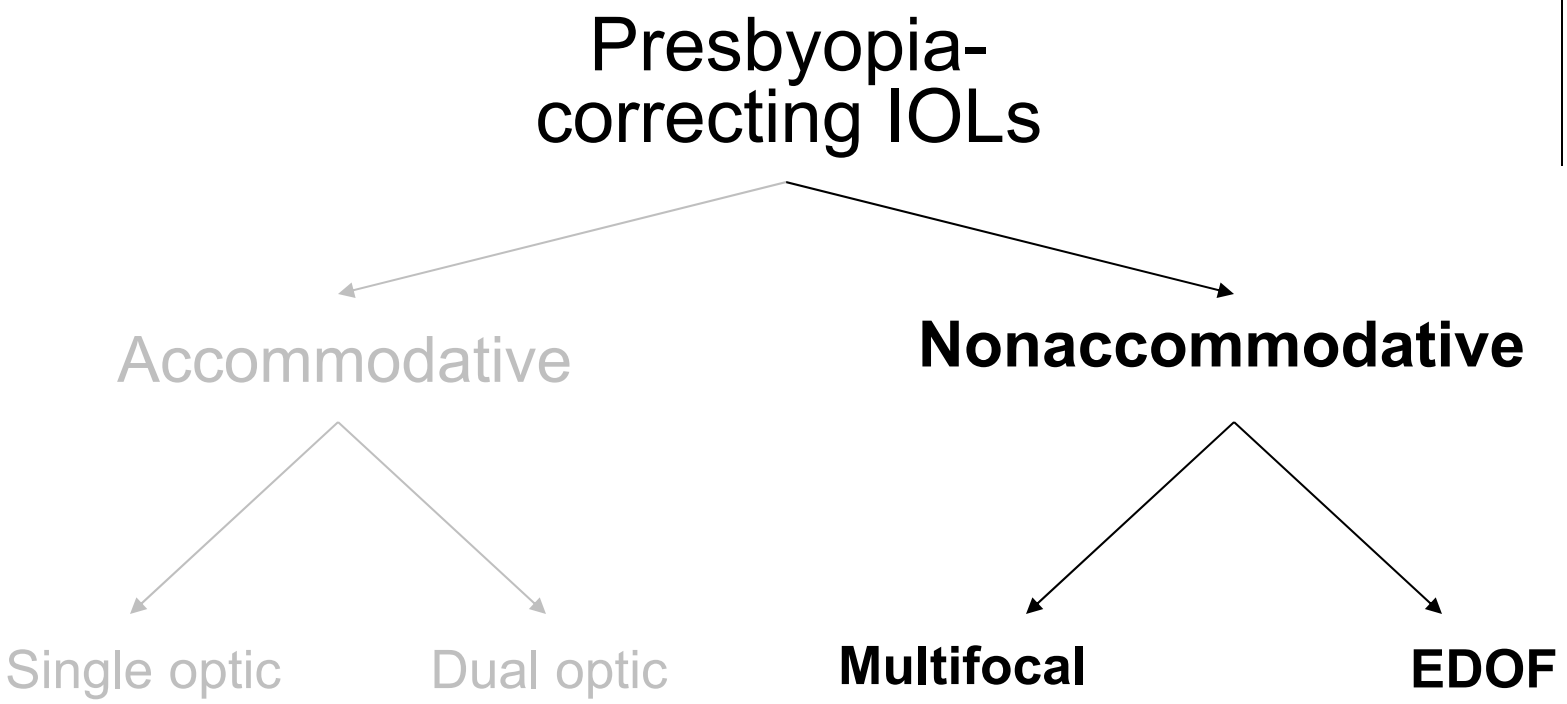
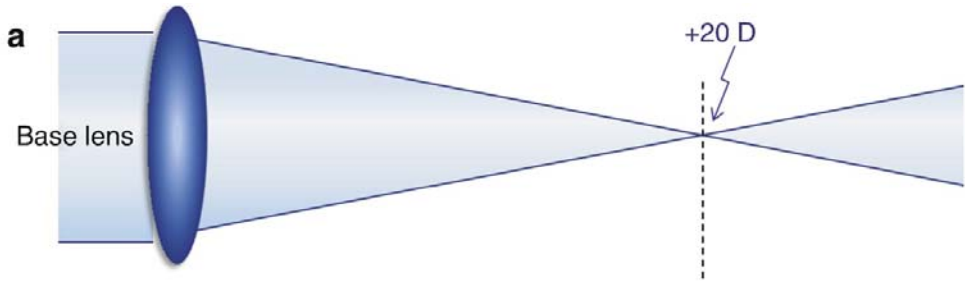
A diffractive multifocal IOL manipulates this interference/reinforcement phenomenon to place a near focal point on the retina.



How are diffractive optics incorporated in nonaccommodative platforms?

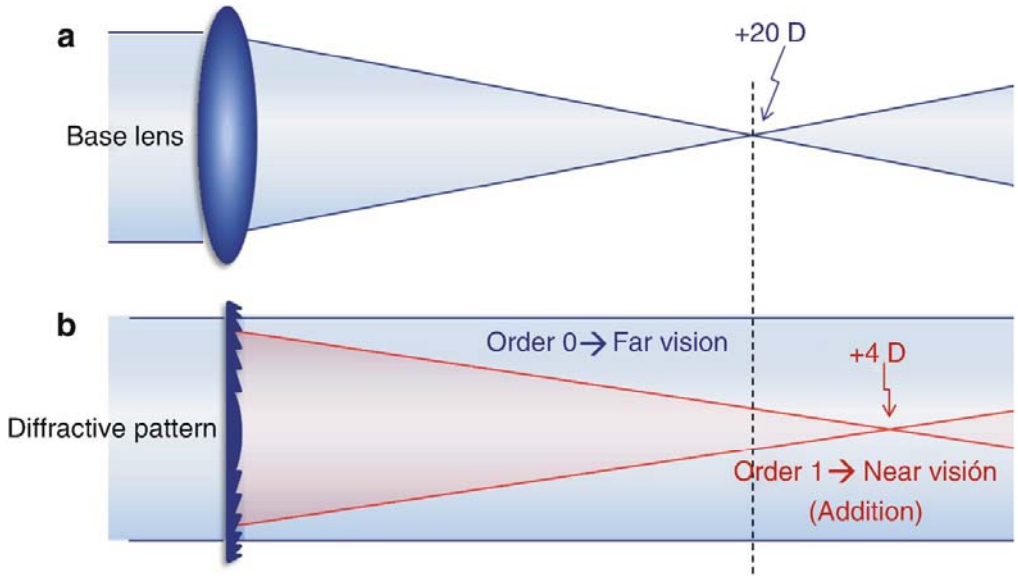


How are diffractive optics incorporated in nonaccommodative platforms?
On the back side. That is, most platforms that deploy diffractive optics have a convex (ie, refractive) anterior surface powered for distance, with diffractive optics etched onto their posterior surface to create additional power for near.



The structure of a diffractive multifocal IOL:

a. A refractive monofocal IOL serves as the base (20D for illustration purposes)



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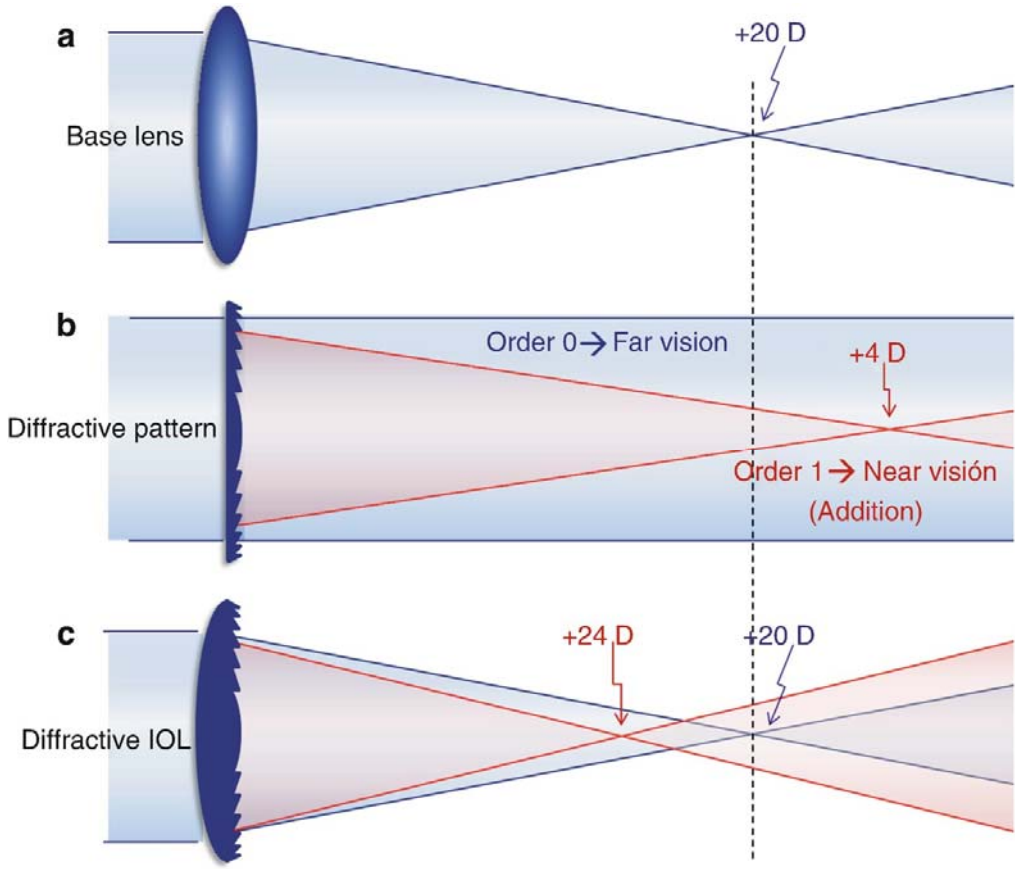

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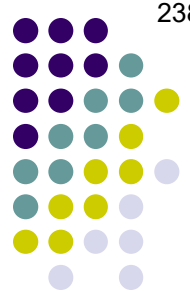
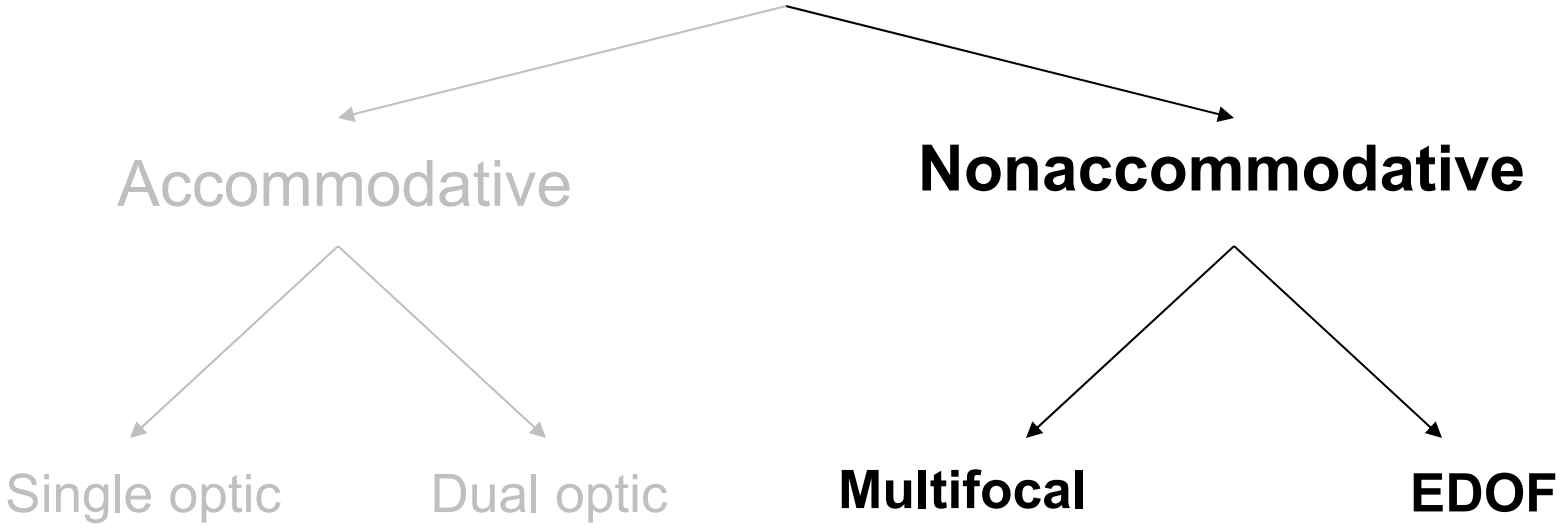
c. When combined, the result is a multifocal IOL with a +4 add



Presbyopia-correcting IOLs



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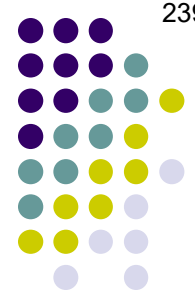
In the context of diffractive IOLs, what does the term apodization *refer to?*



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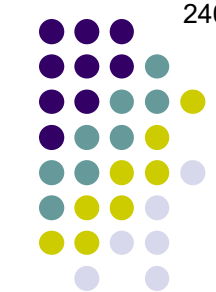
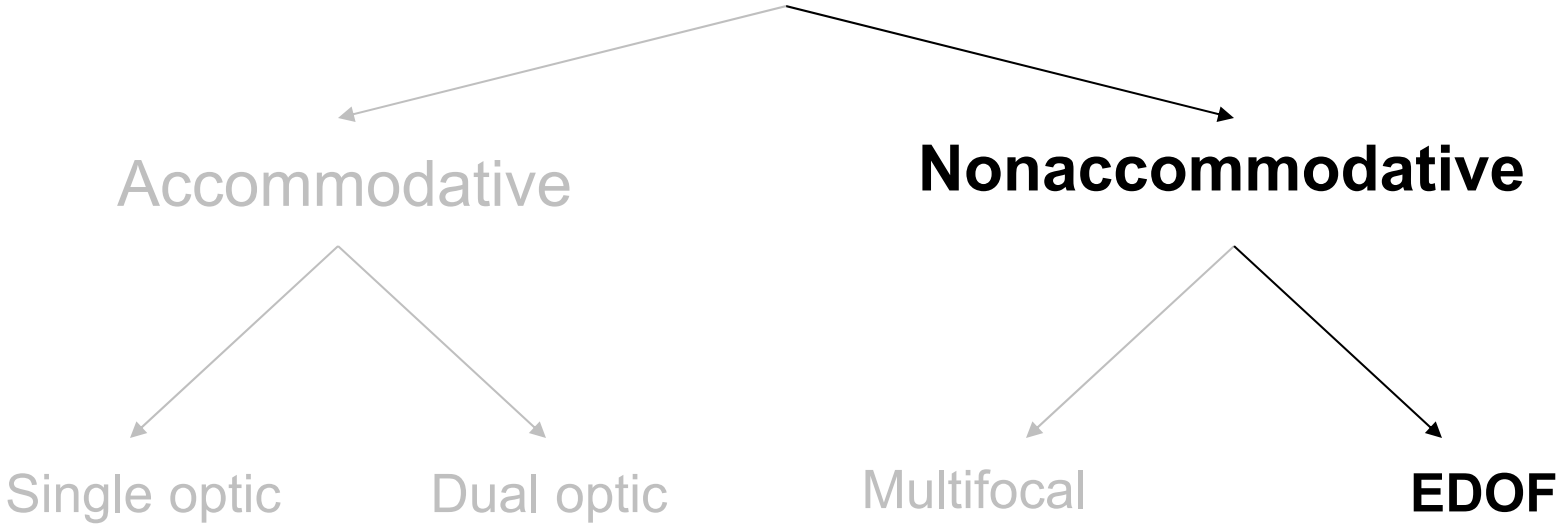
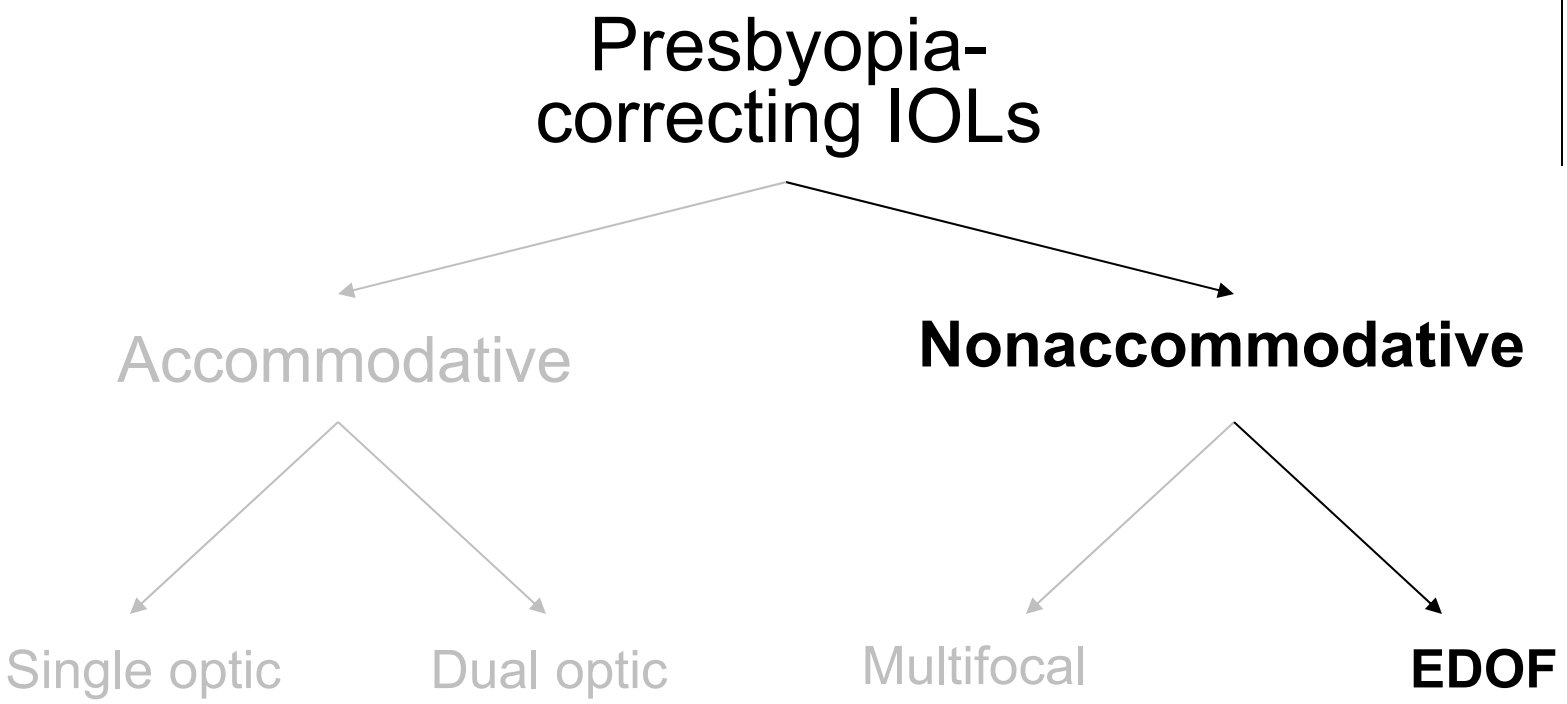
It refers to tapering or smoothing out of the diffractive steps carved into the IOL. The idea is that, by employing smaller diffractive steps, this will allow for the formation of images *between* distance and near, thus facilitating vision at intermediate distances.



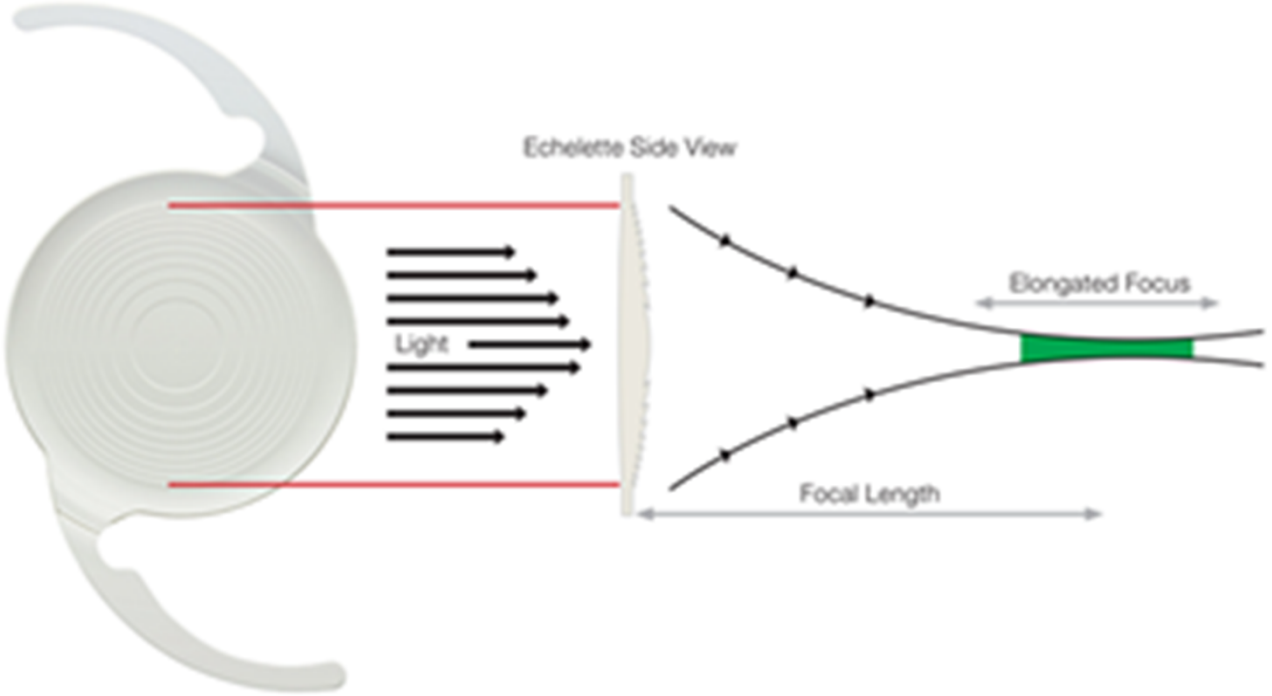


How do EDOF *IOLs produce an EDOF?*

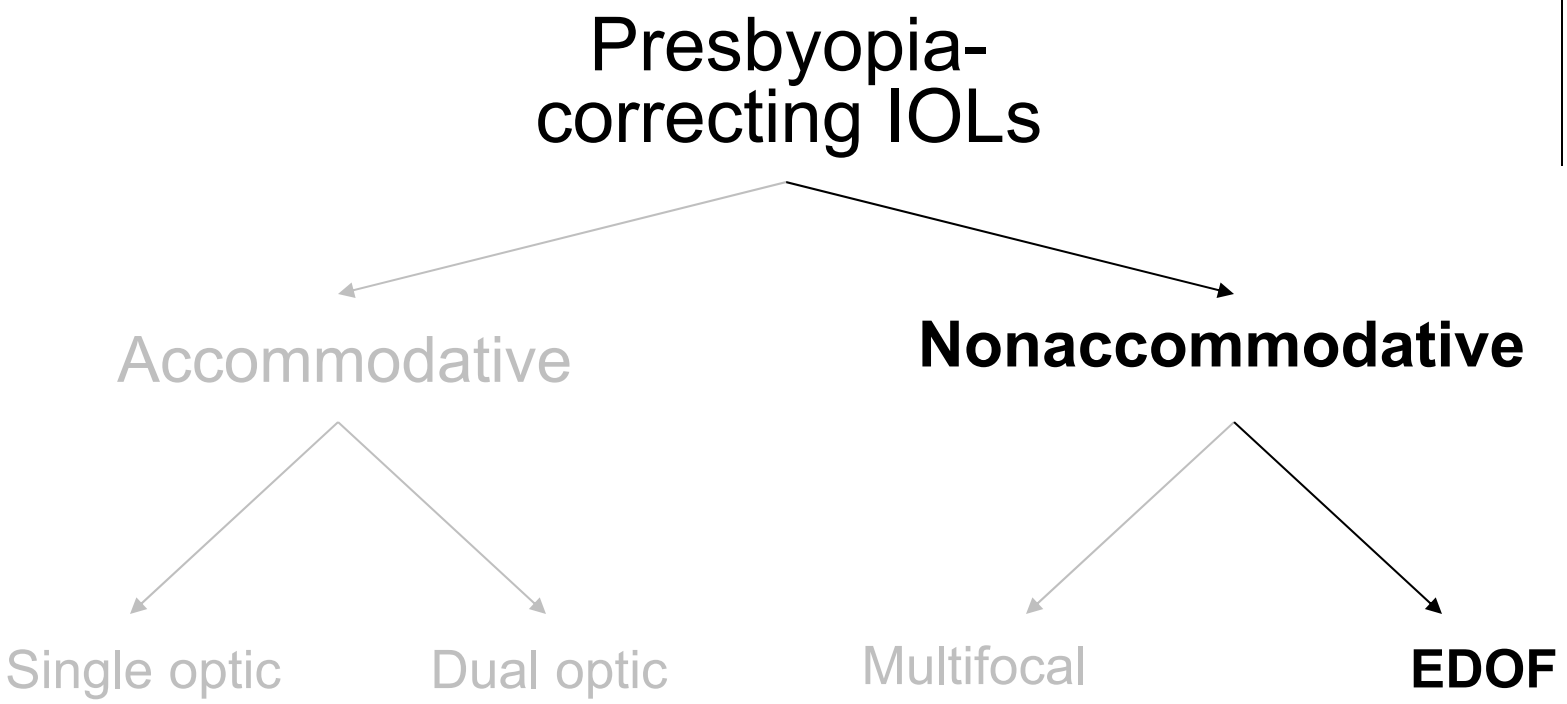


How do EDOF *IOLs produce an EDOF?*

Extended depth of focus can be achieved via multiple techniques. One FDA-approved platform uses diffractive optics.



EDOF multifocal IOL employing diffractive optics



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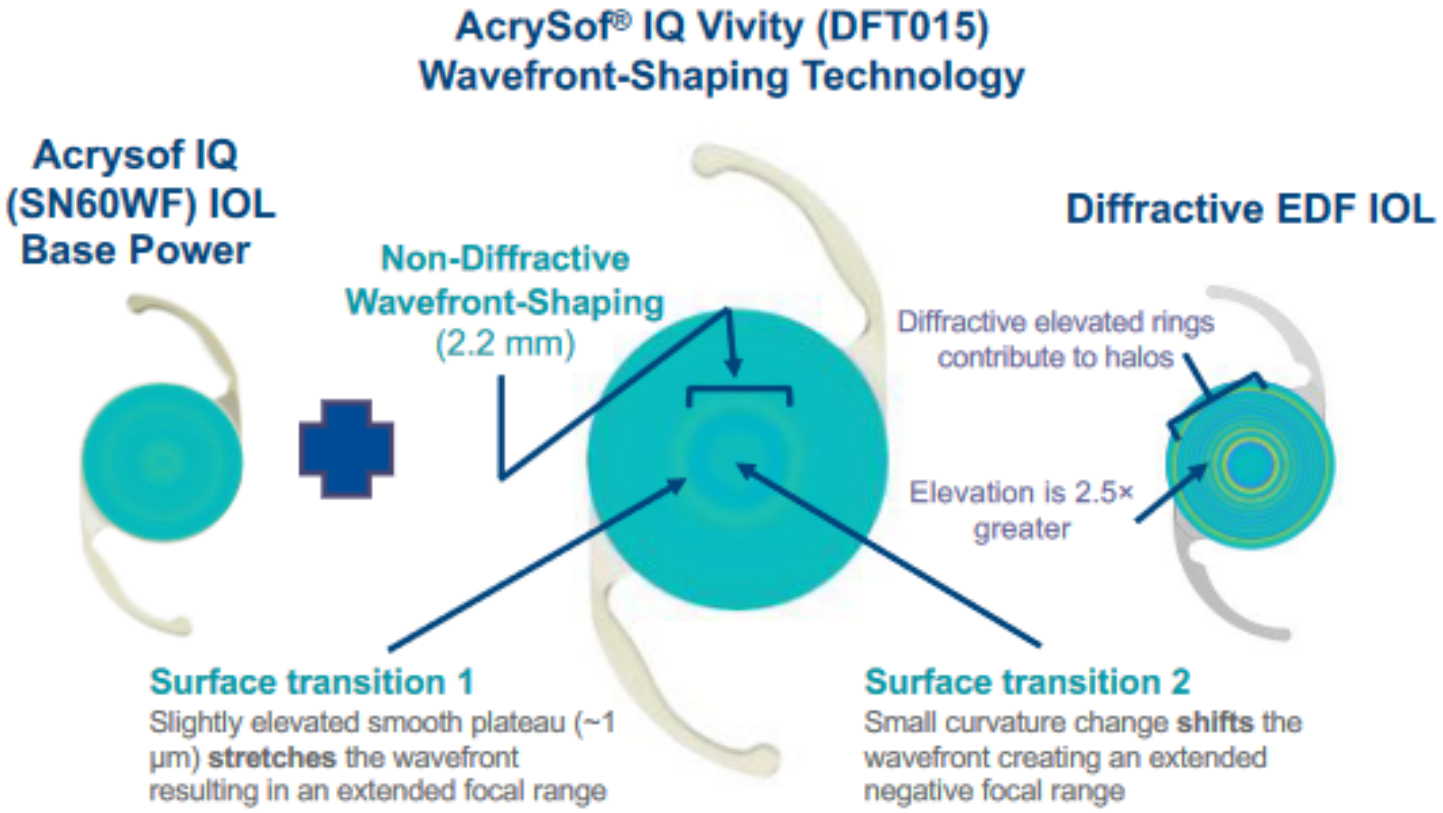
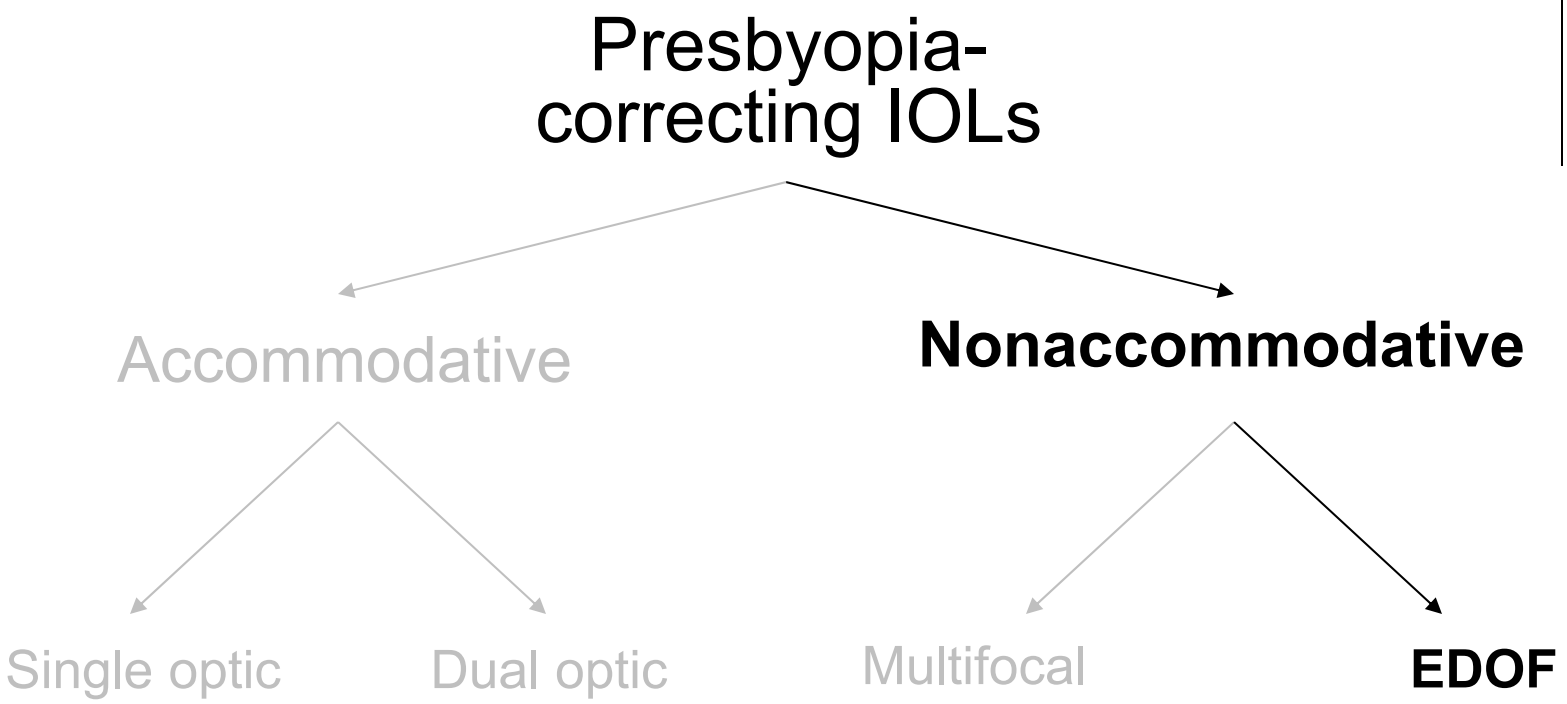


EDOF multifocal IOL employing non-diffractive optics



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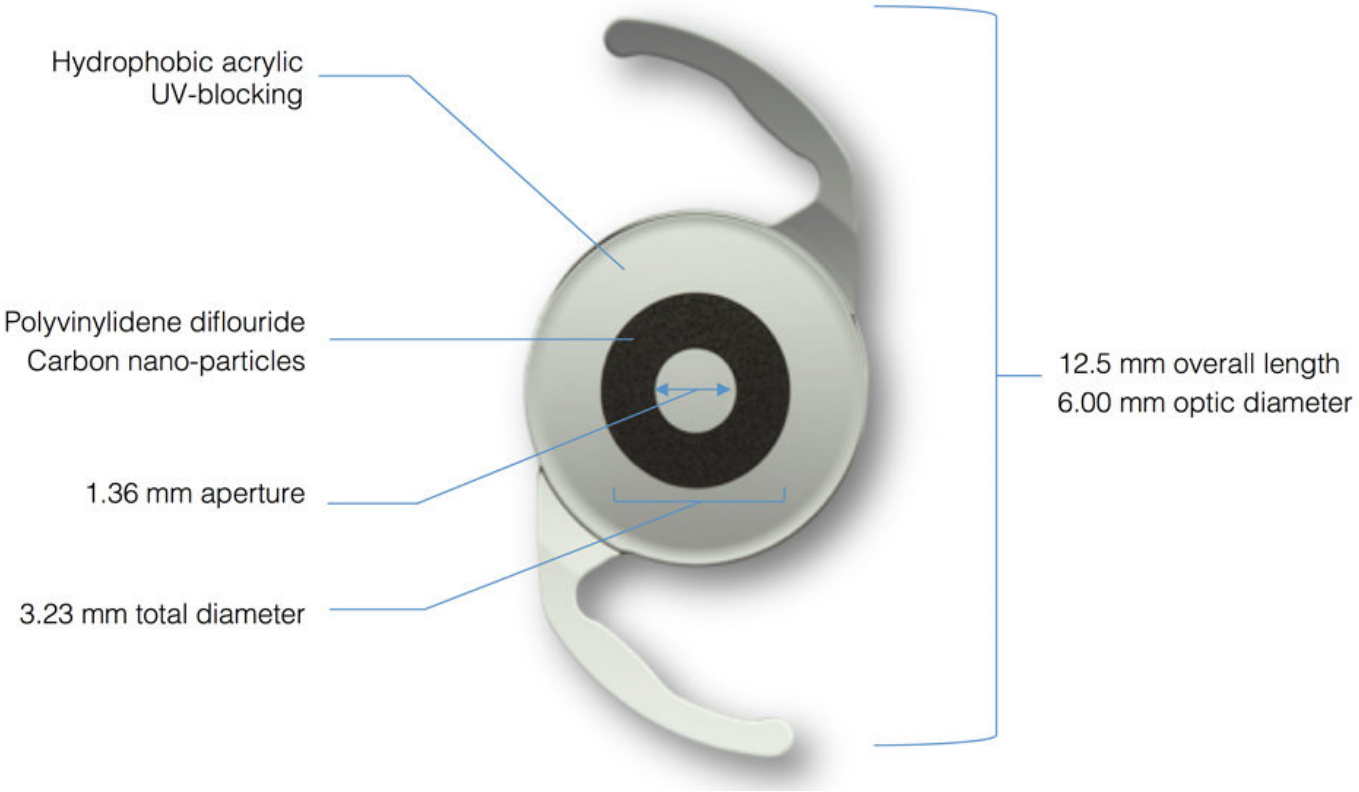
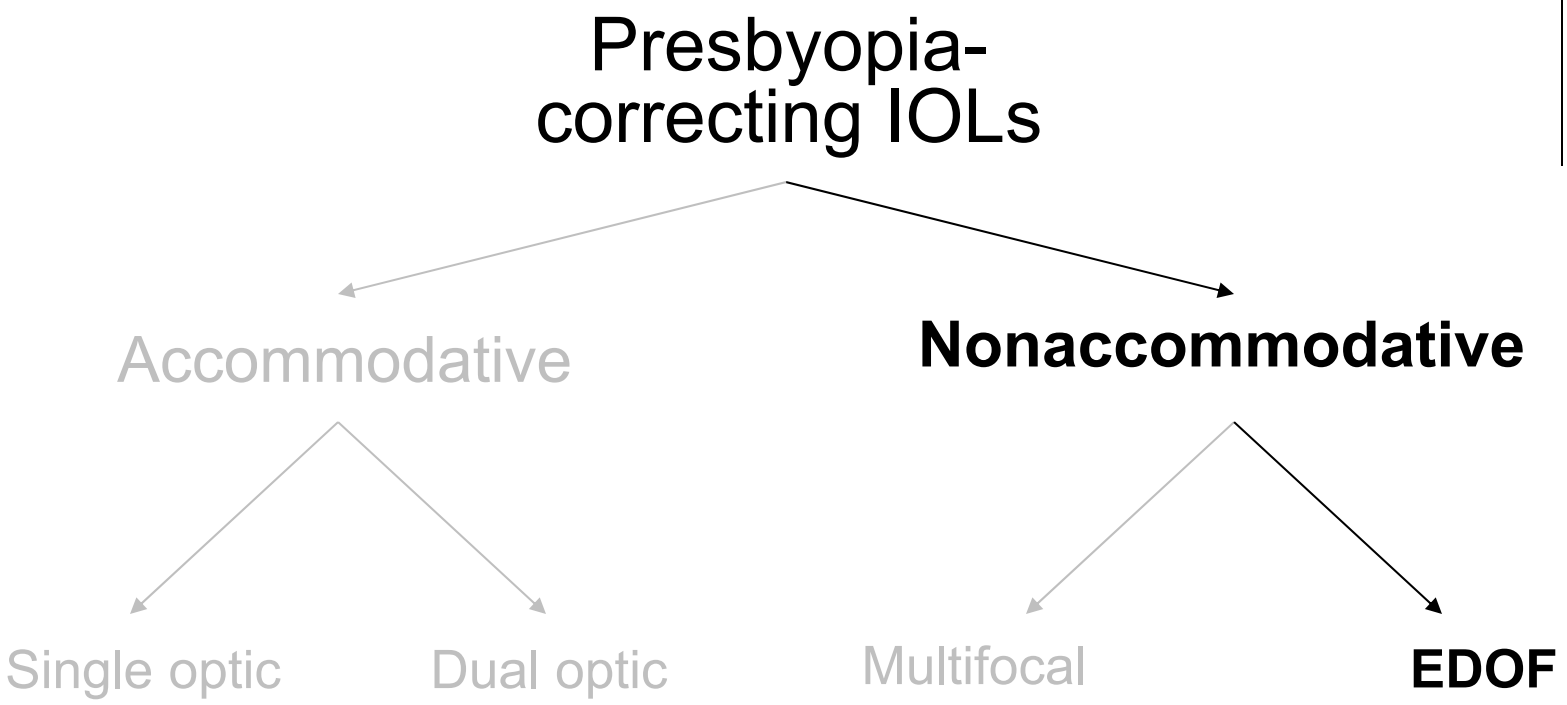
The IC-8® Small Aperture IOL



EDOF multifocal IOL employing the pinhole effect



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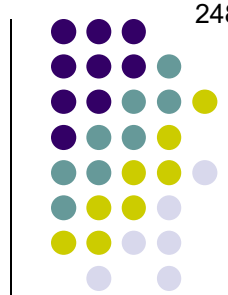

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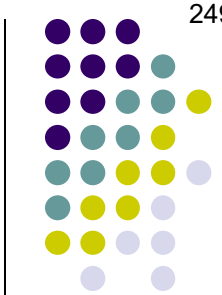

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Sin

EDOF

Hol up—what about near?
If an EDOF IOL is powered for distance, the extent of the depth-of-focus—ie, the range of clear vision it provides—will not include near

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. Another employs
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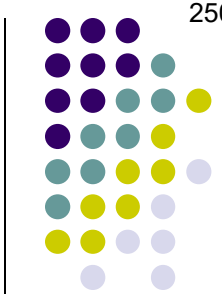

Presbyopia-correcting IOLs

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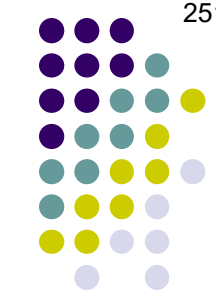

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What can the surgeon do to provide the potential for spectacle-free vision via EDOF lenses?
She can go with a mini-monovision strategy. By pushing the zone back a little in one eye, vision in the 'near' range can be provided.

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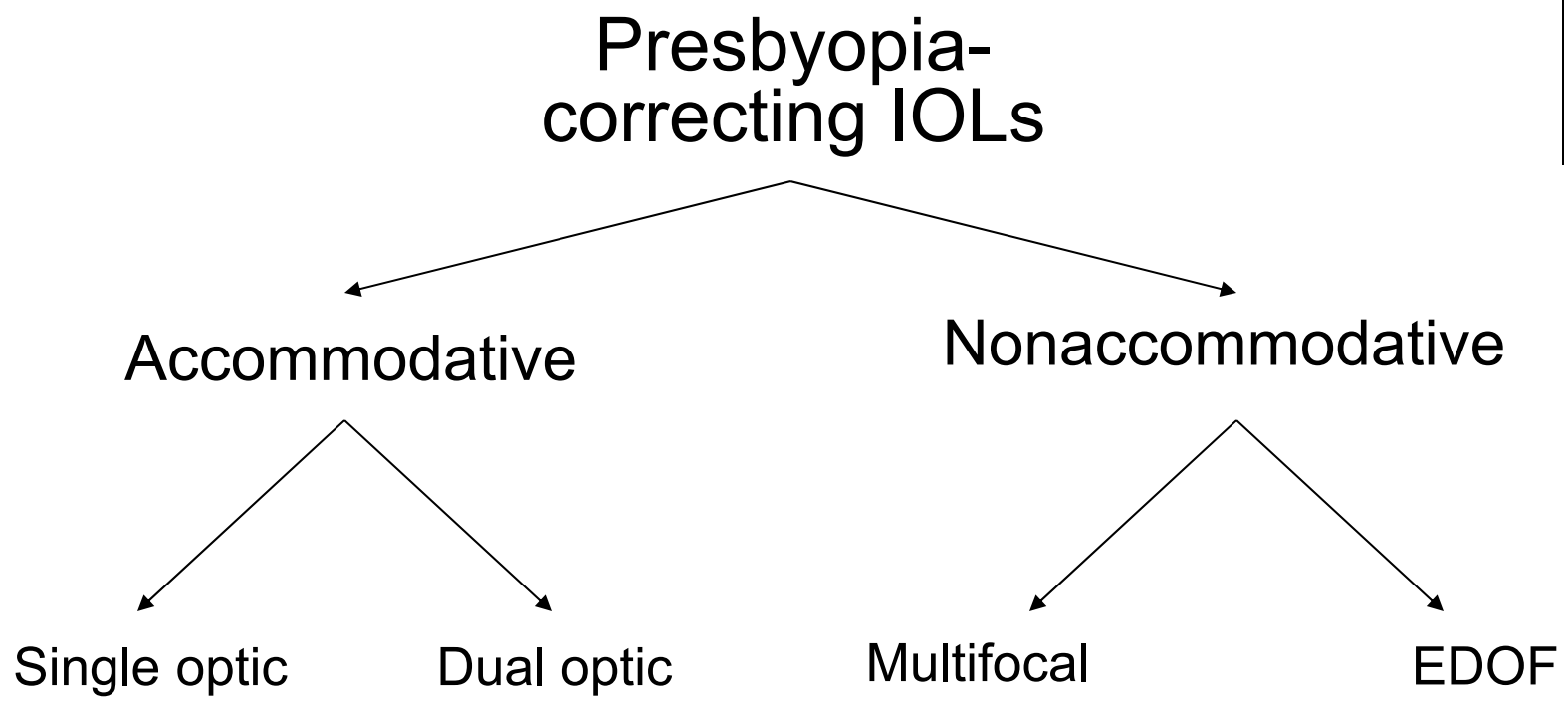

Comparing accommodative and nonaccommodative approaches to presbyopia-correcting IOLs:

What are the advantages of the accommodative approach?

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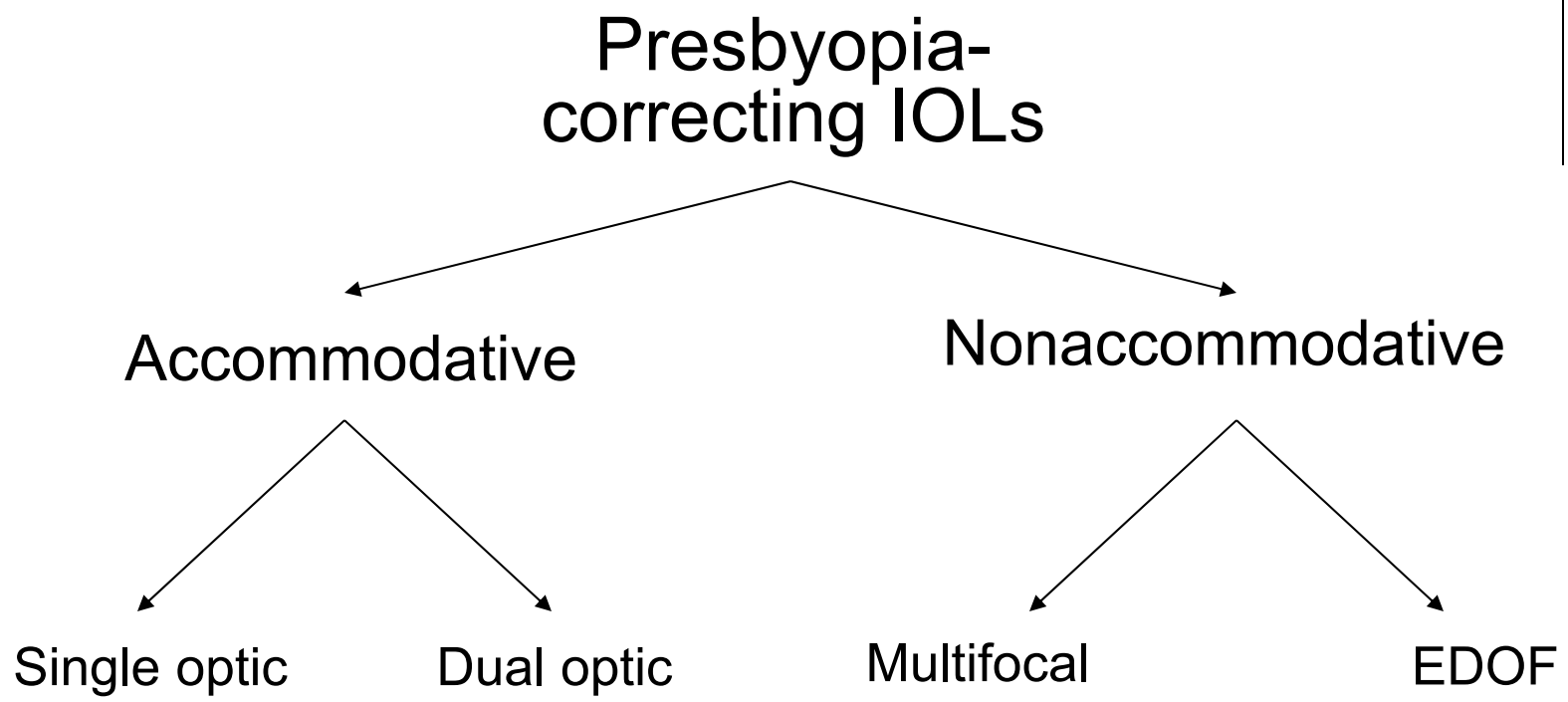

Comparing accommodative and nonaccommodative approaches to presbyopia-correcting IOLs:

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--Lack of dysphotopsias (haloes, etc)

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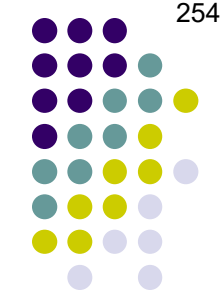

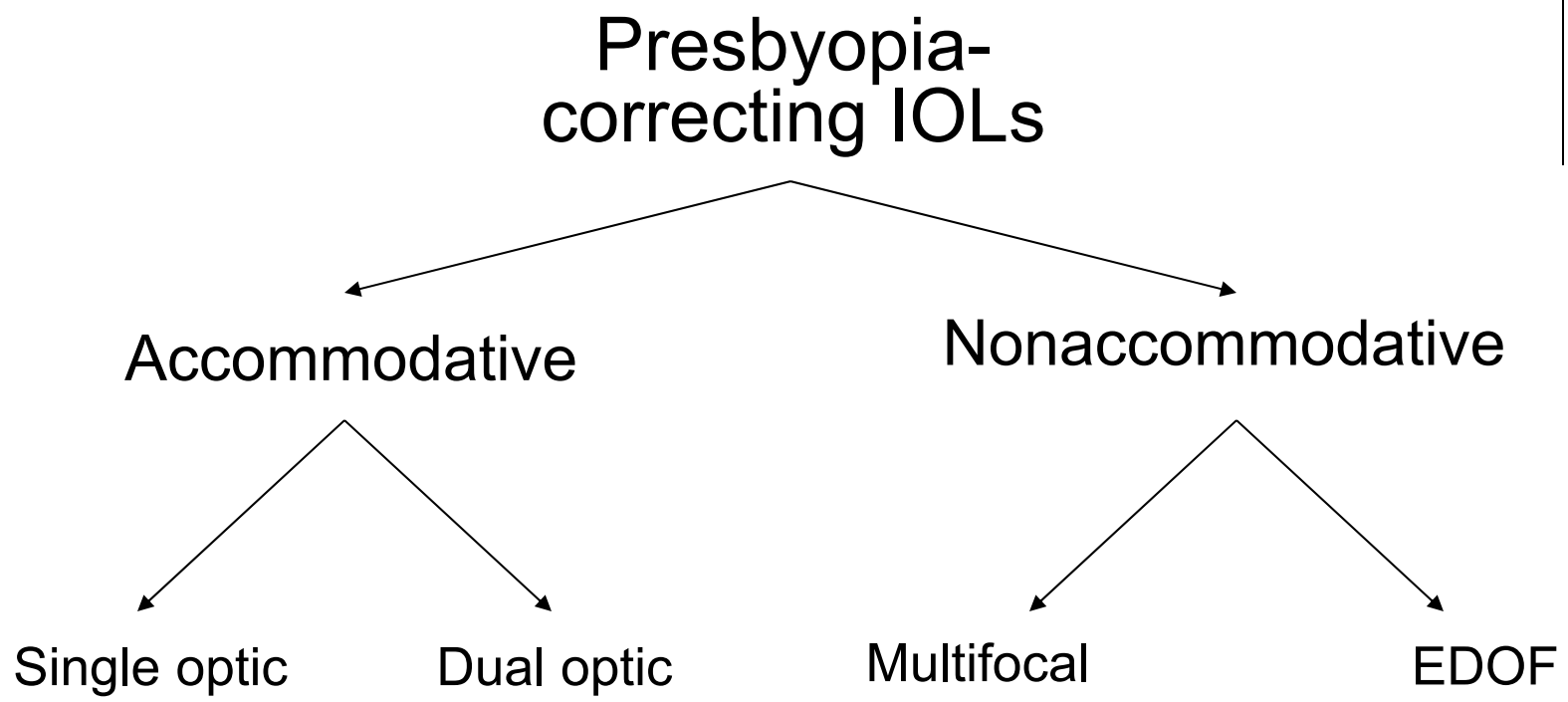

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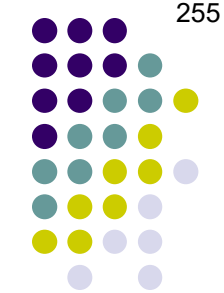

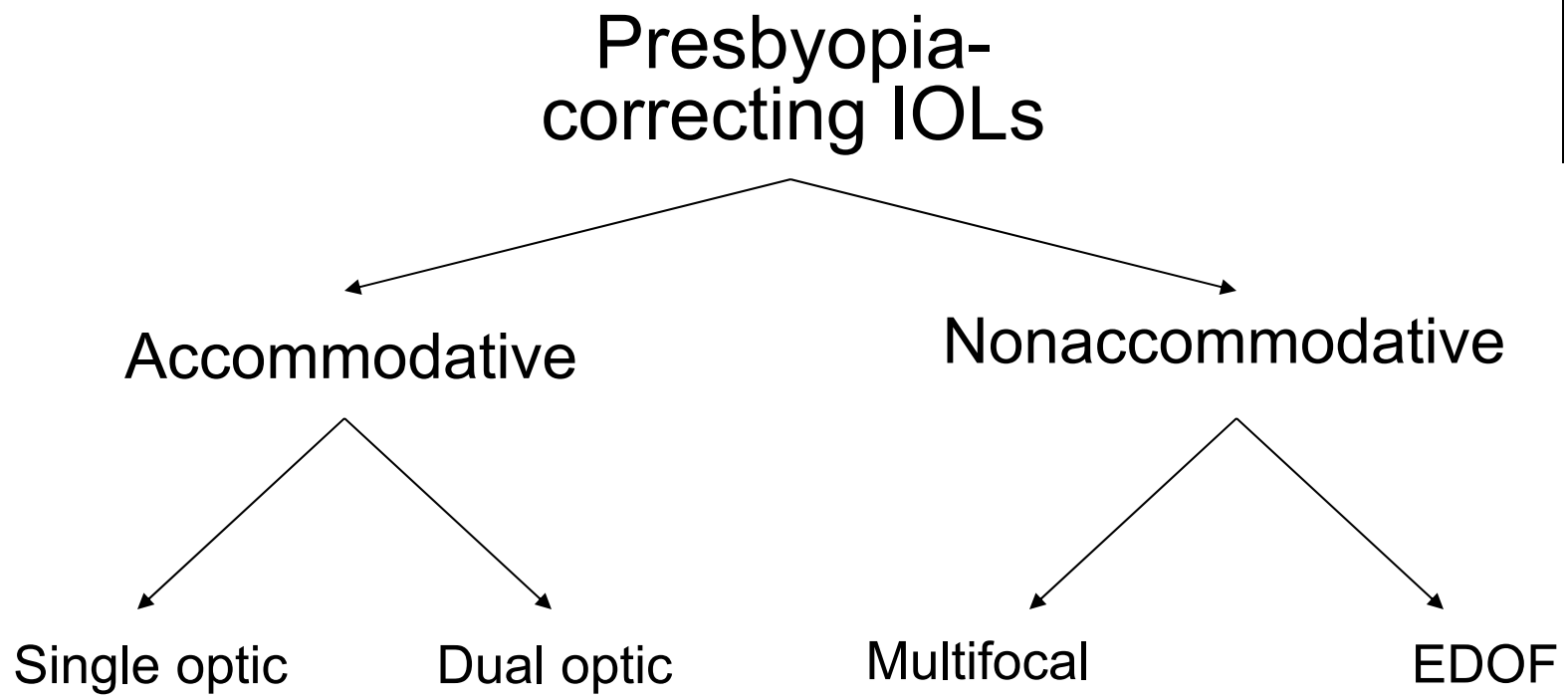

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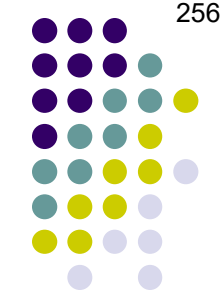

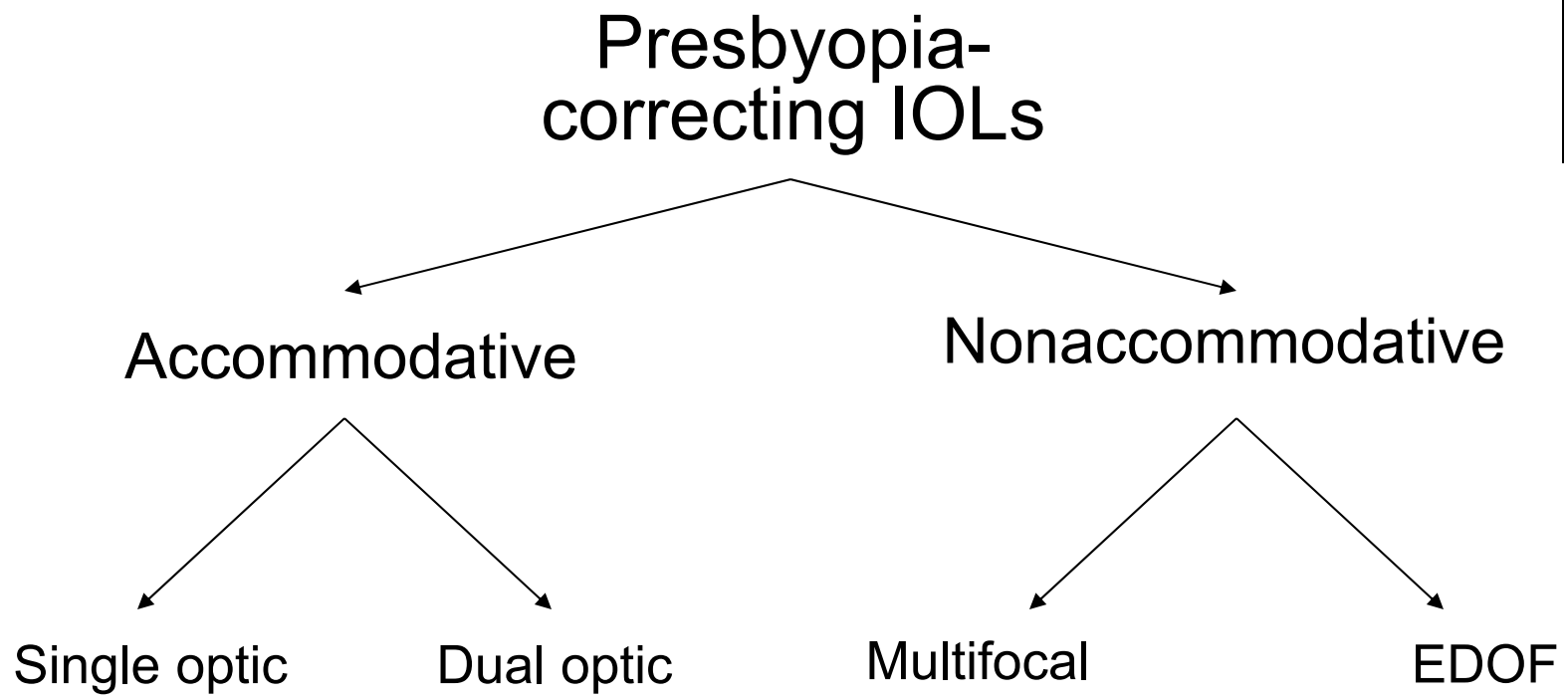

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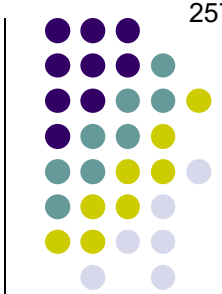

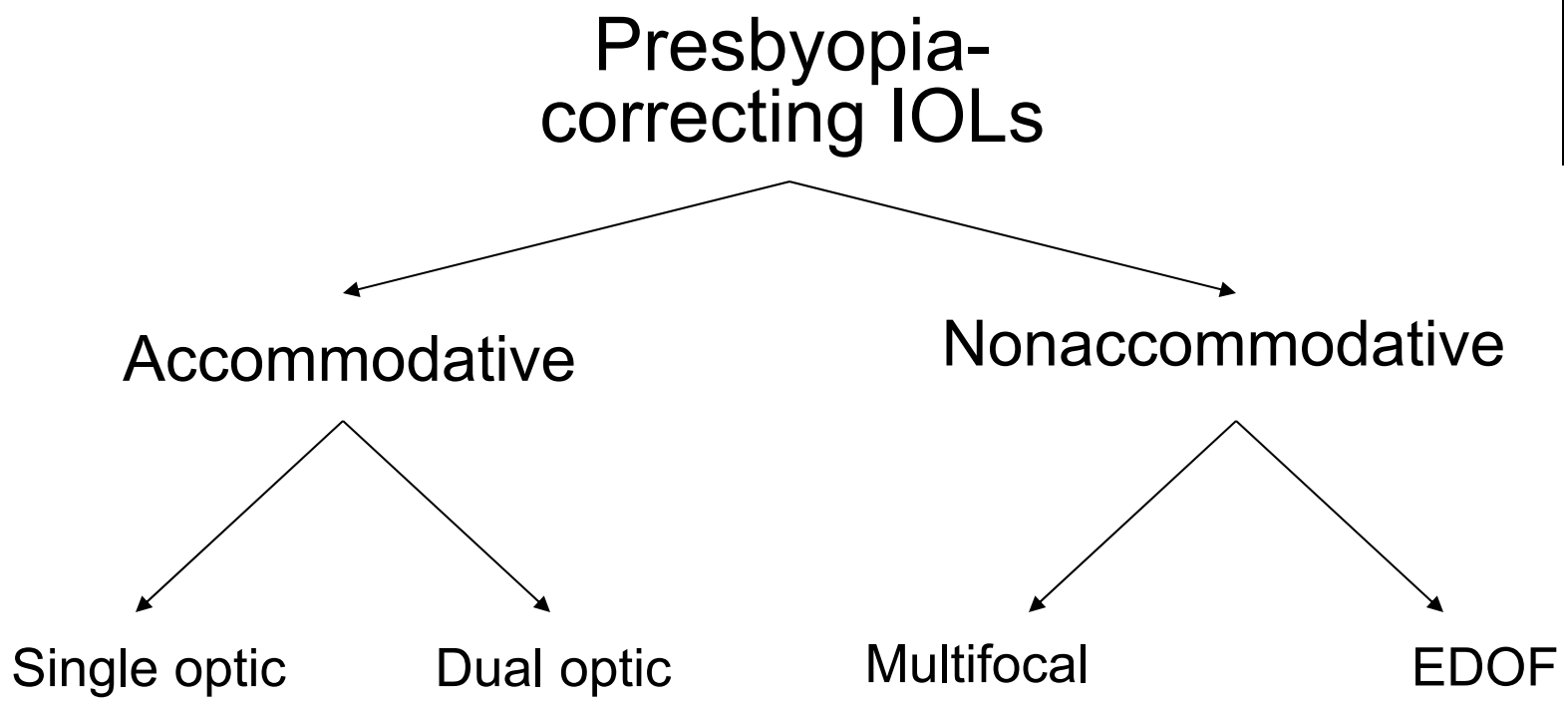

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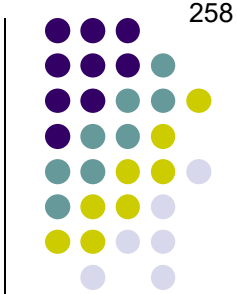

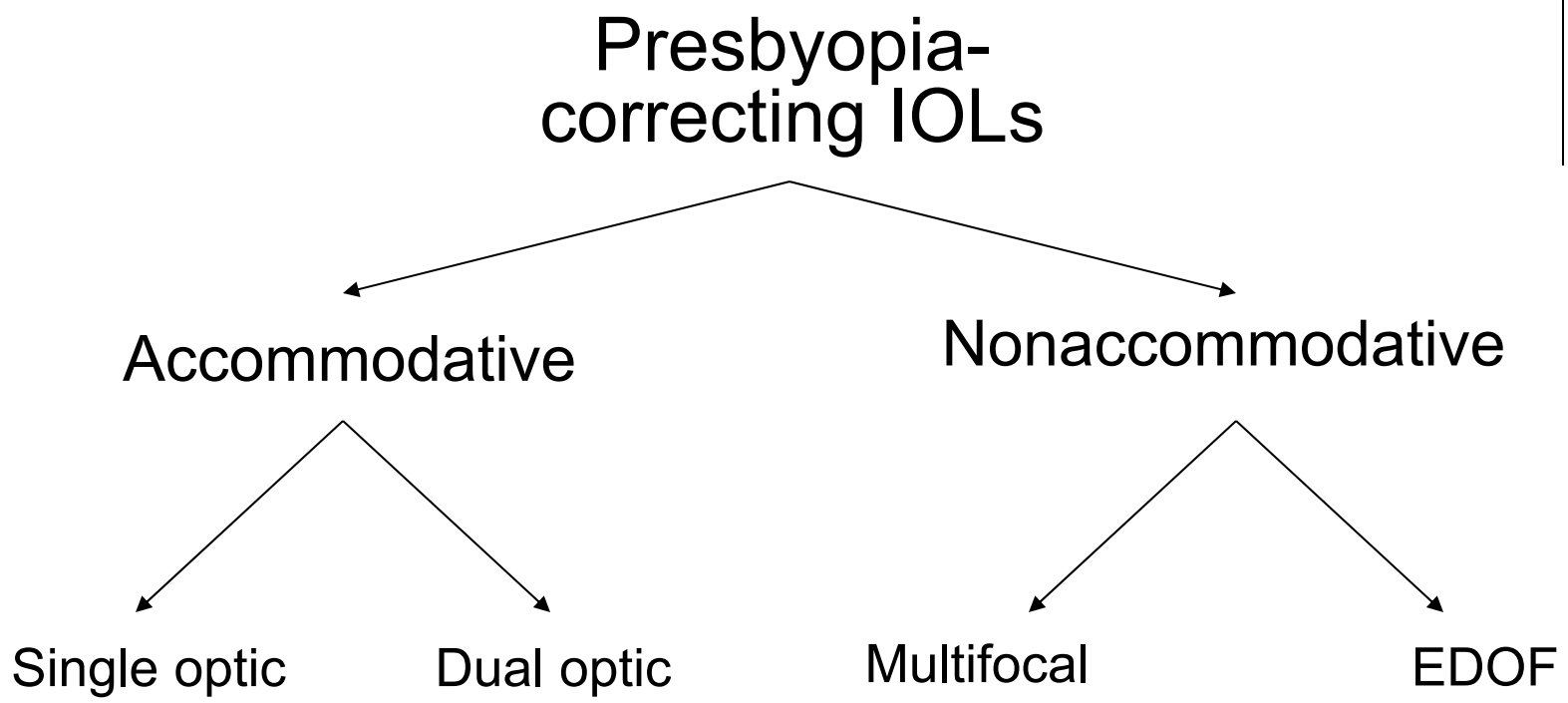

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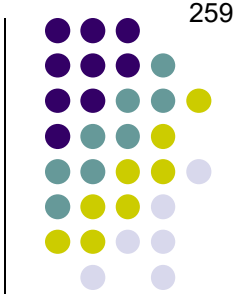

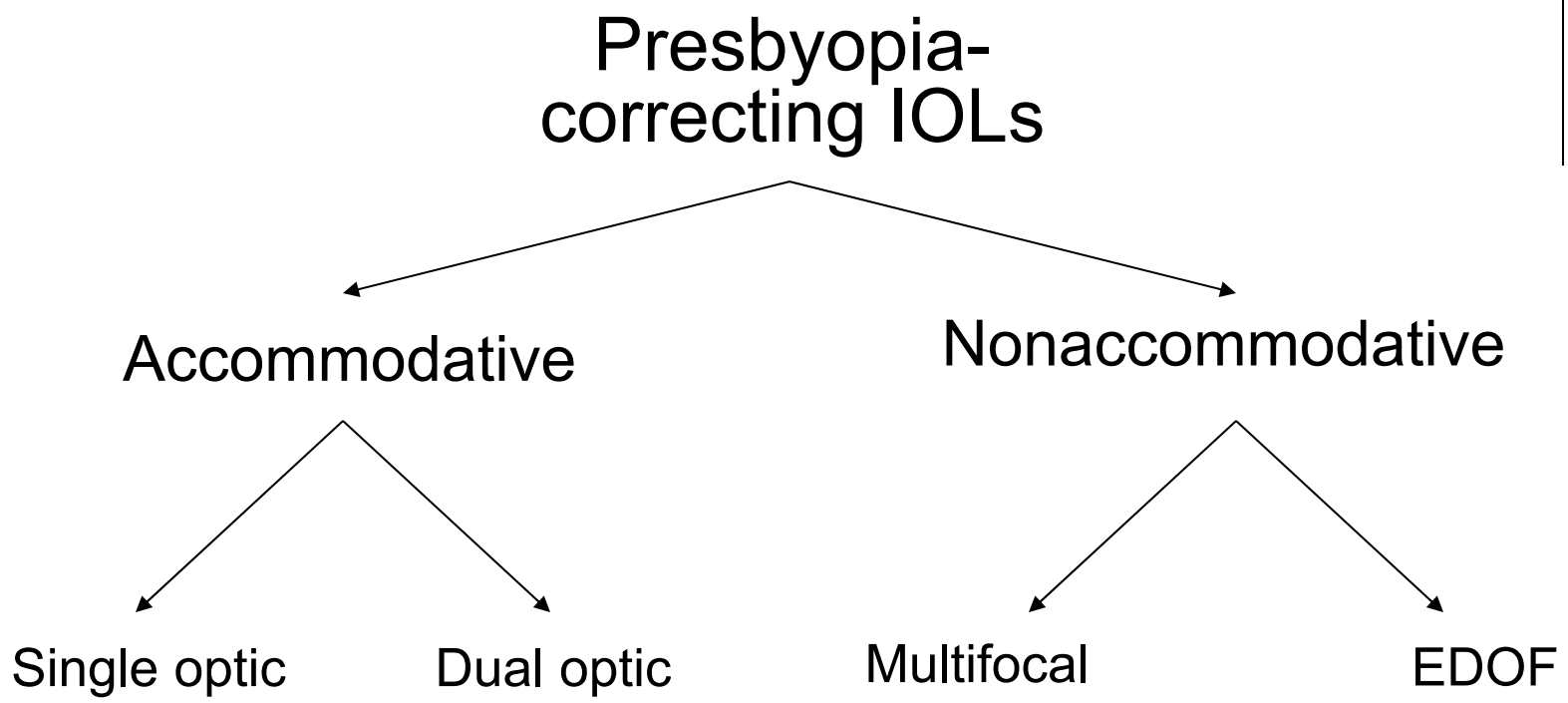

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What are the disadvantages of the multifocal approach?
--Dysphotopsias (e.g., haloes) are common
--Decreased contrast sensitivity
--Compromises at some distances are inevitable