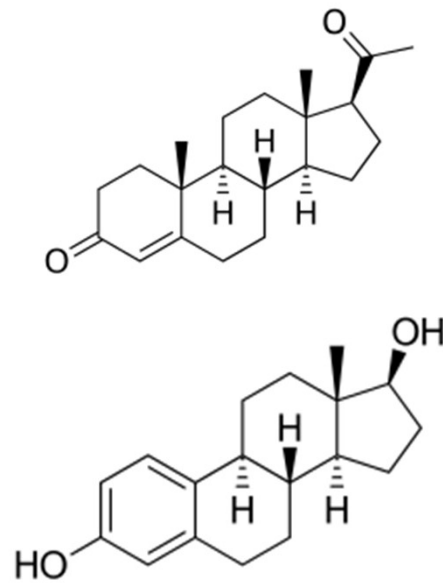


# The Effects of Female Hormones on the Eye throughout the Life Cycle of Women

Desinee Drakulich O.D.  
Truhlsen Eye Institute  
Department of Ophthalmology



1

## A little bit about me

- Born and raised in Omaha, NE
- Studied chemistry and biology at the University of Nebraska Omaha
- Studied Neuropharmacology at University of Nebraska Medicine
- Studied Optometry at Salus University in Philadelphia
- Practiced in private practice for 11 years
- Joined Nebraska Medicine 6 years ago
- Primary focus is diagnosis, treatment and management of ocular trauma and disease

2

# Disclosures

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I HAVE NO FINANCIAL DISCLOSURES



NO OFF-LABEL MEDICATION USE  
WILL BE DISCUSSED IN THIS LECTURE

3

# Objectives

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1

Discuss fluctuations of female hormones at various stages of life and their impacts on the health of the eye.

2

Describe the anatomy of the eye and how hormonal changes throughout a woman's life cycle can affect its structure and function.

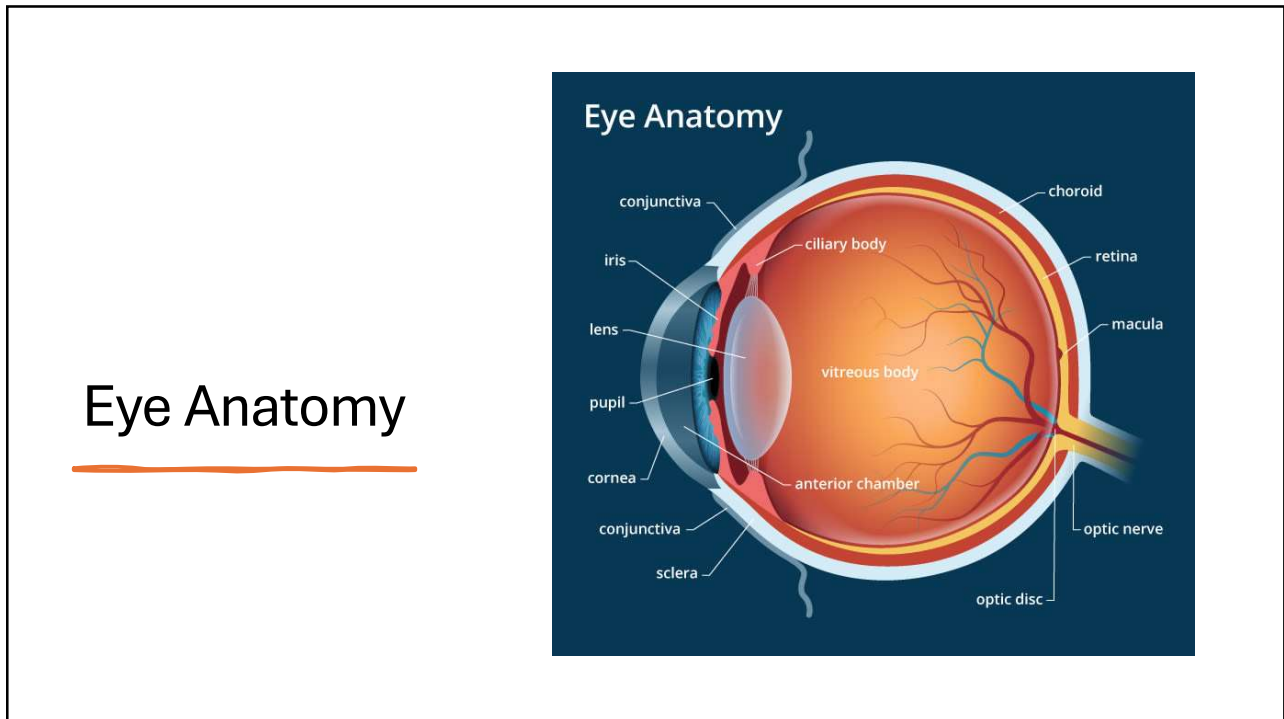
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Identify the relationship between female hormonal changes and the prevalence of specific eye diseases.

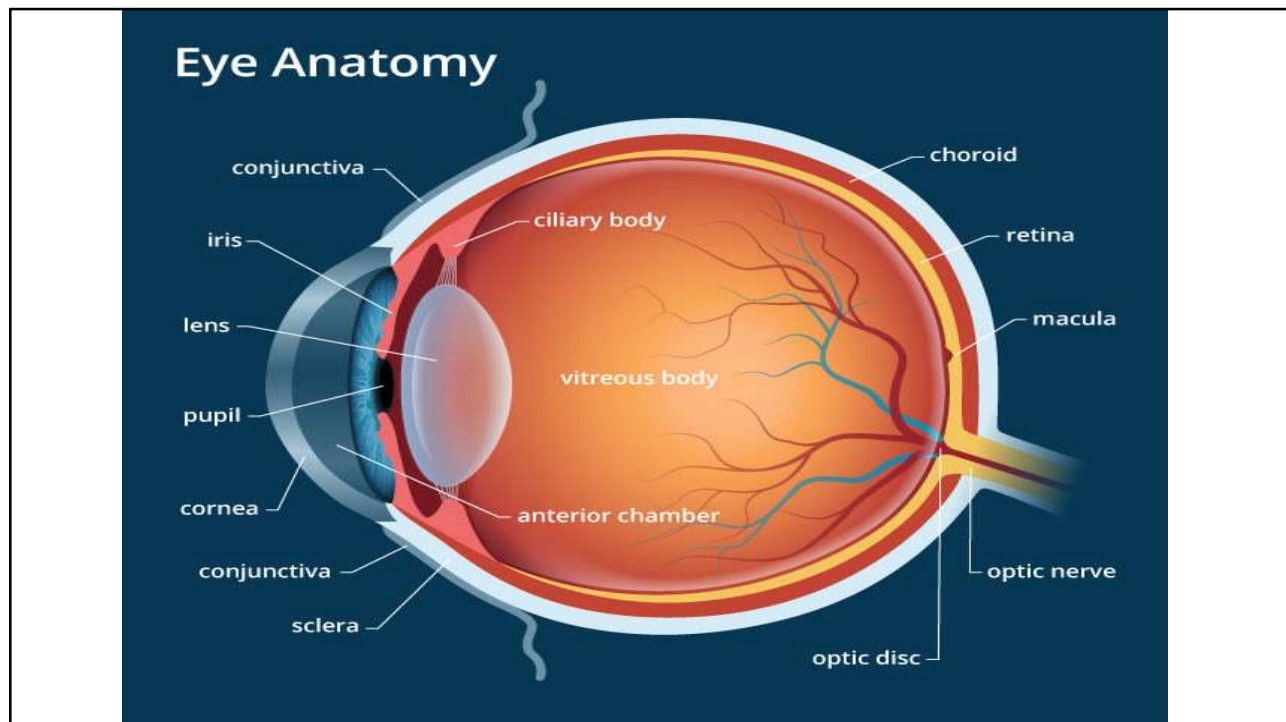
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# Ocular Anatomy

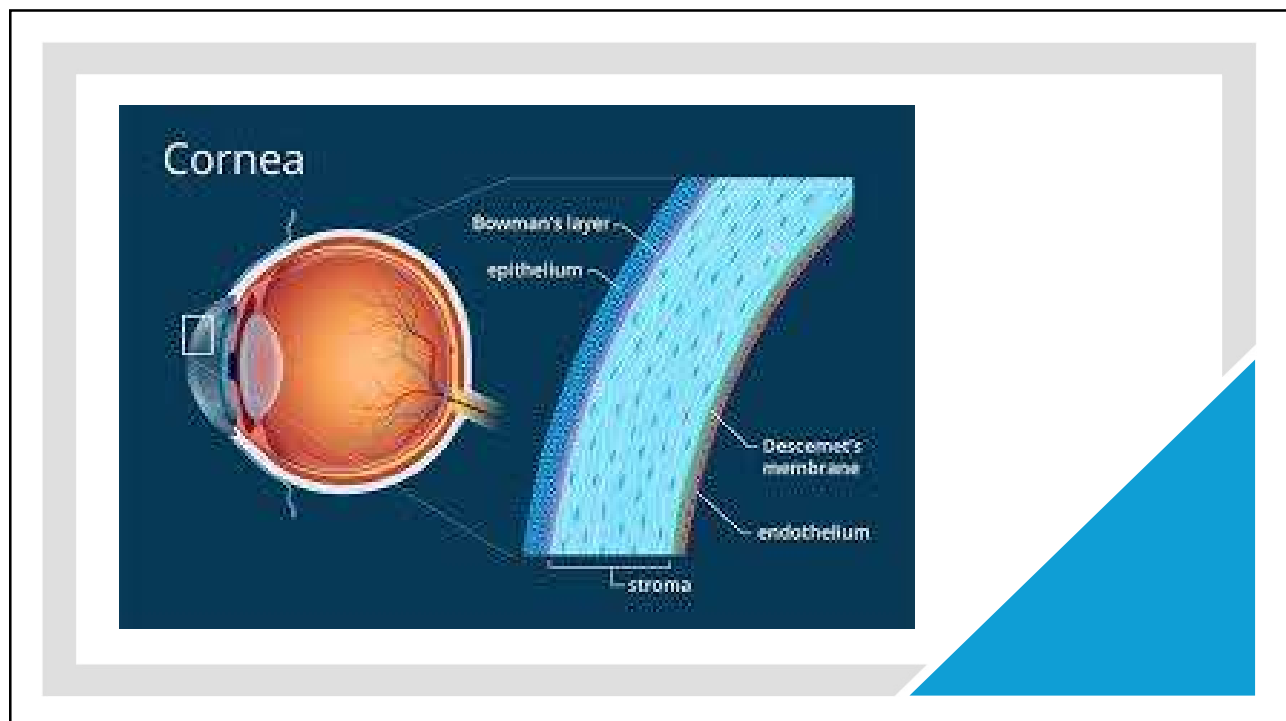
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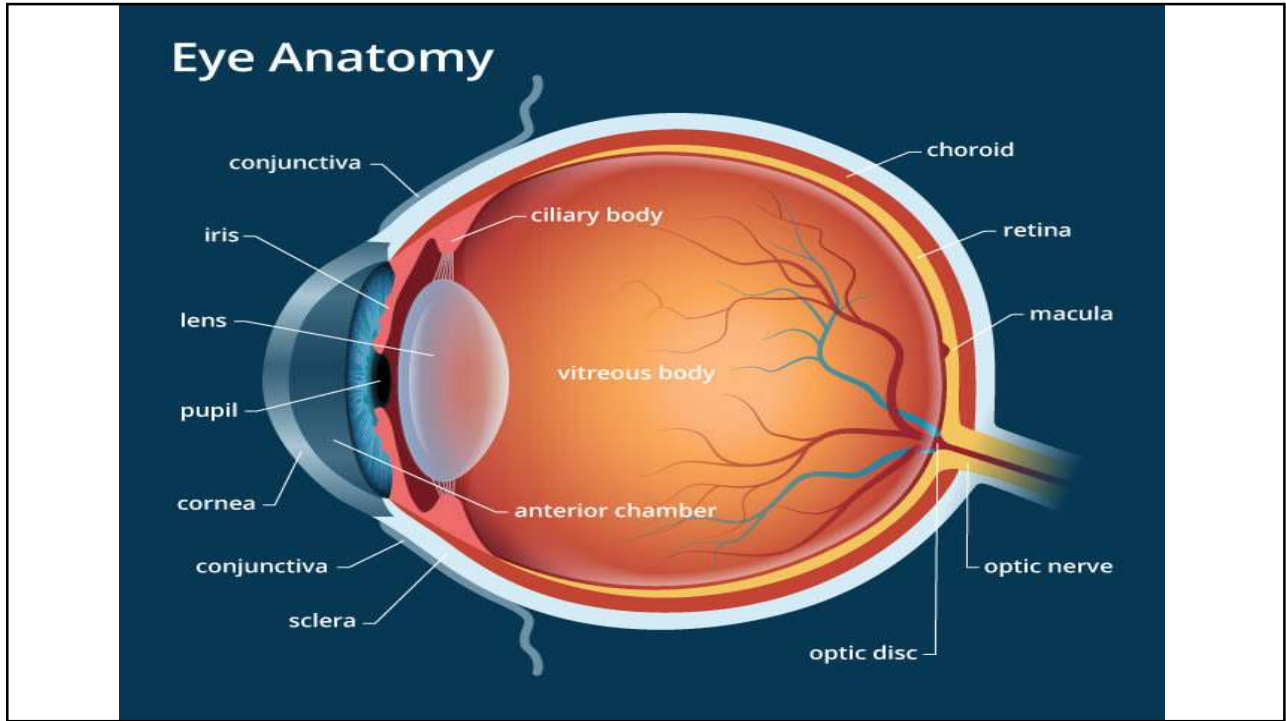
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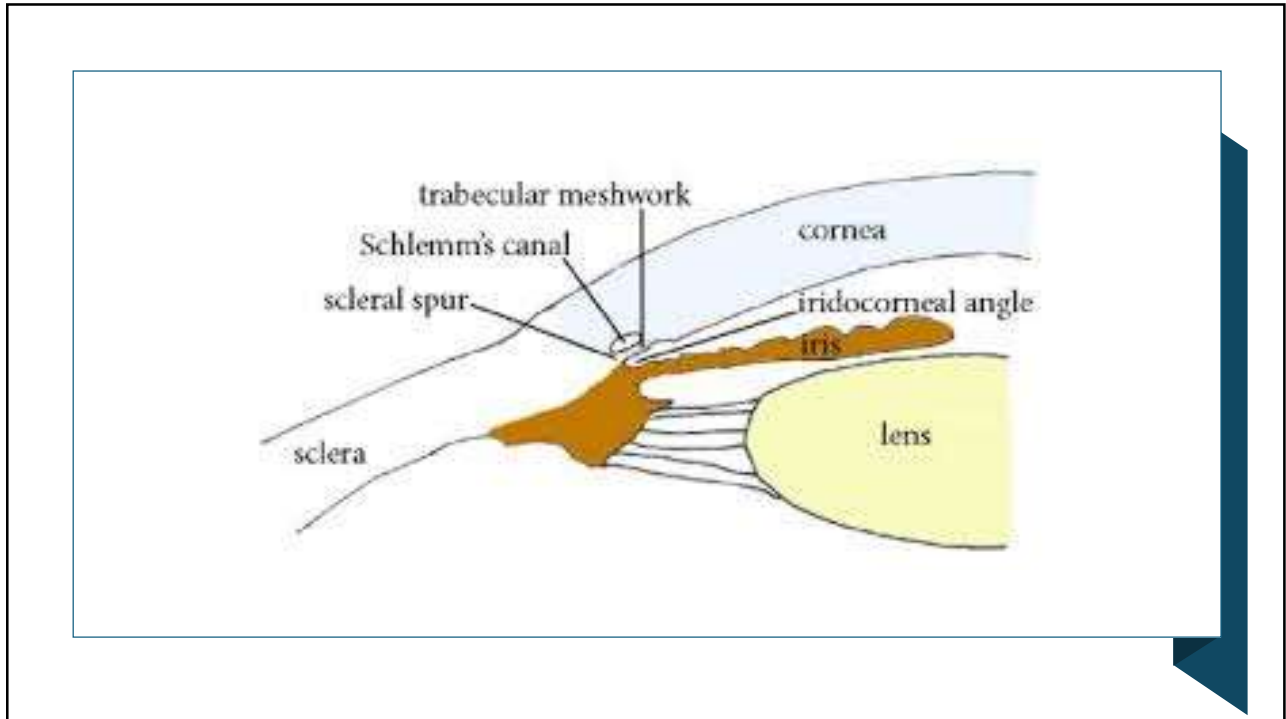
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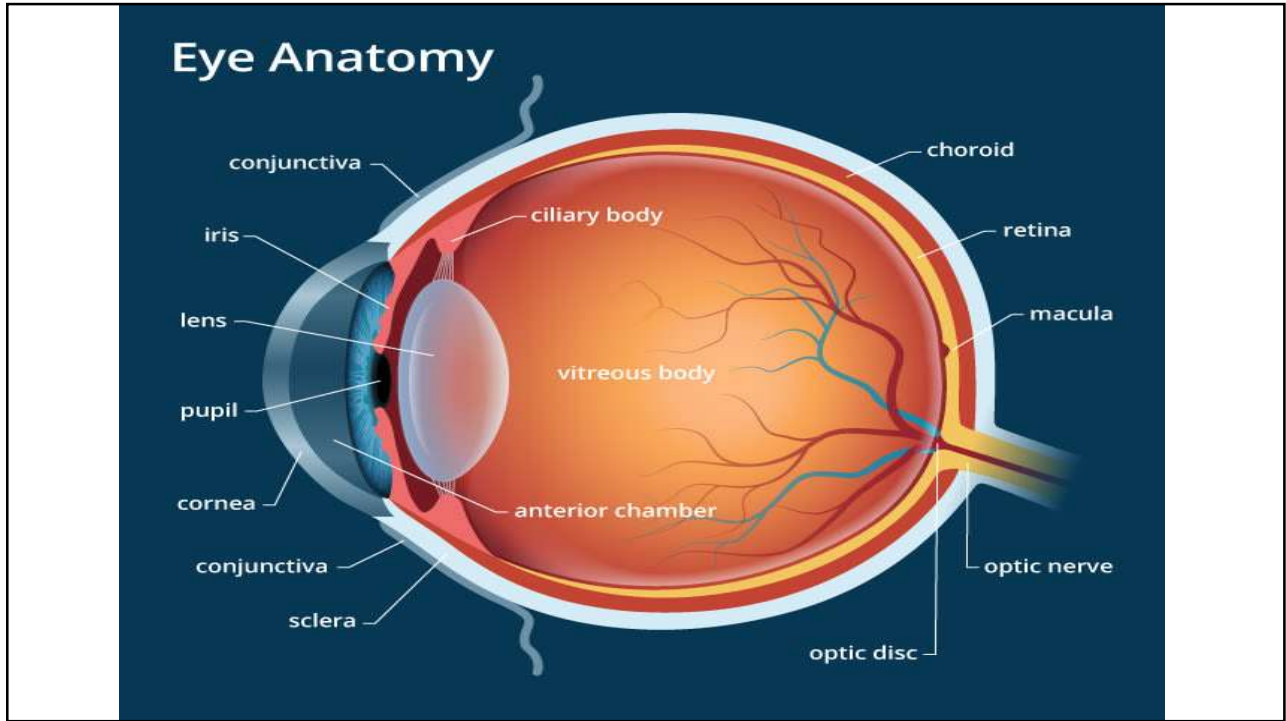
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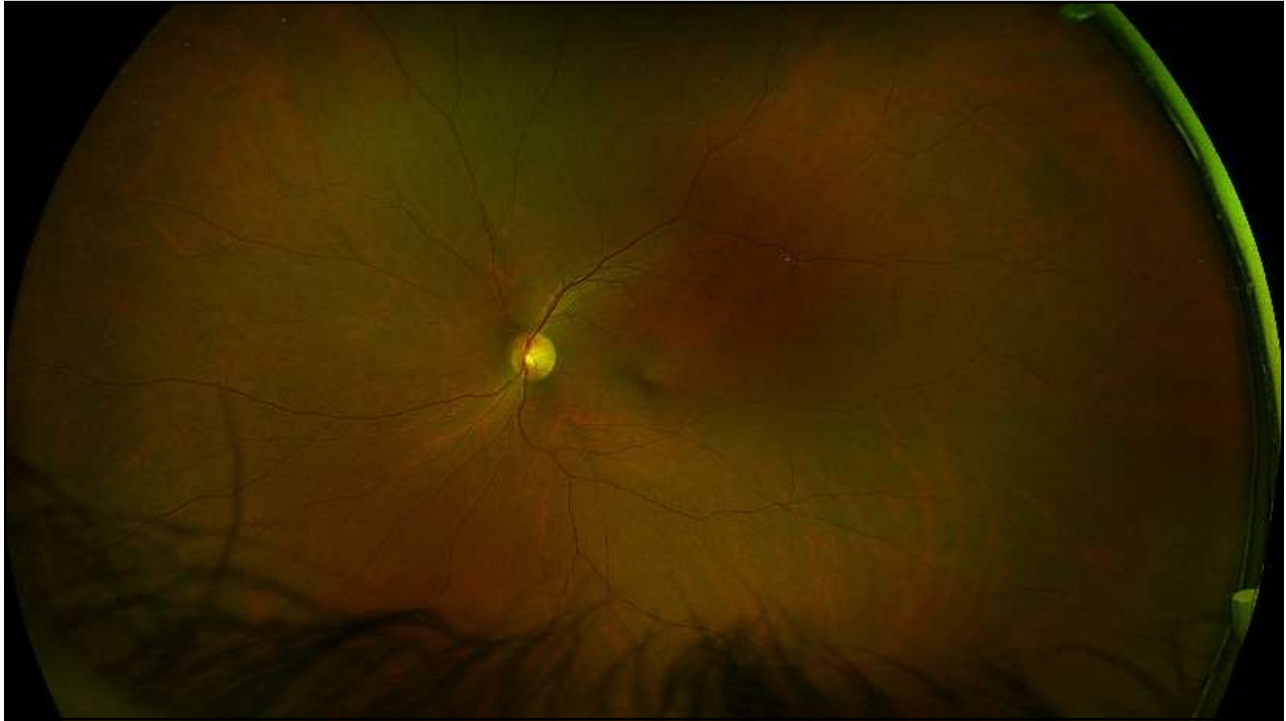
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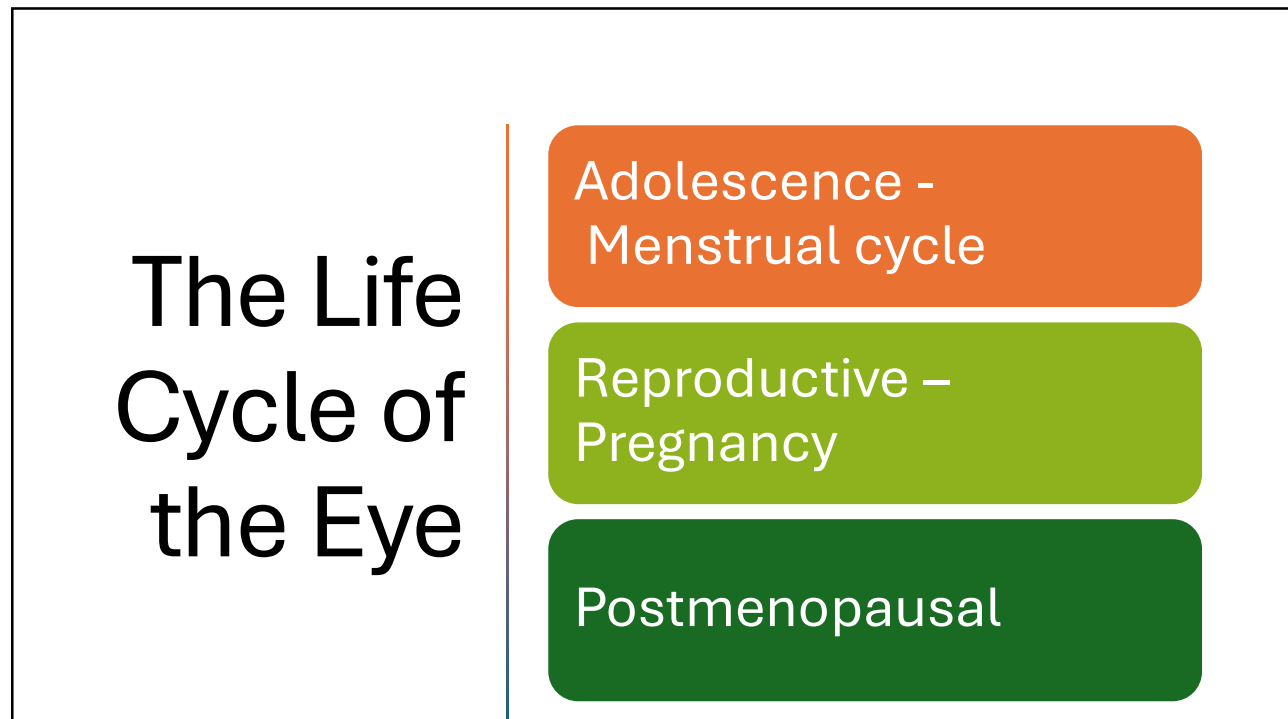
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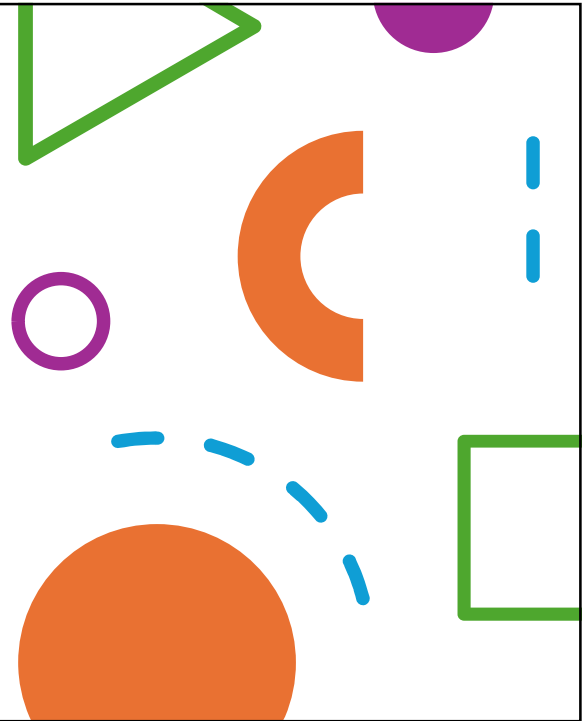
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14

## Focusing on

- Cornea
- Conjunctiva
- Eyelids
- Lens
- Retina
- Optic nerve



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## The Cornea, Conjunctiva and Eyelids

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Probably the most notable structures  
effect by hormonal changes

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Change in tear production

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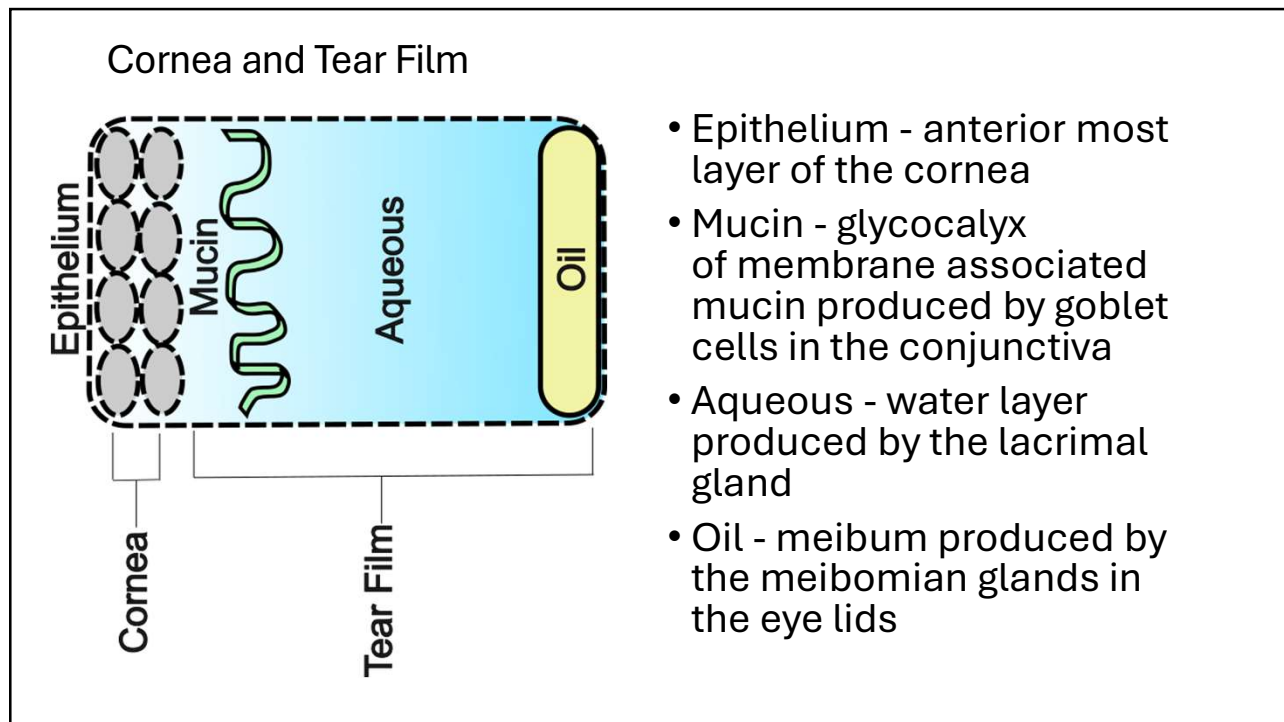
Changes in oil production

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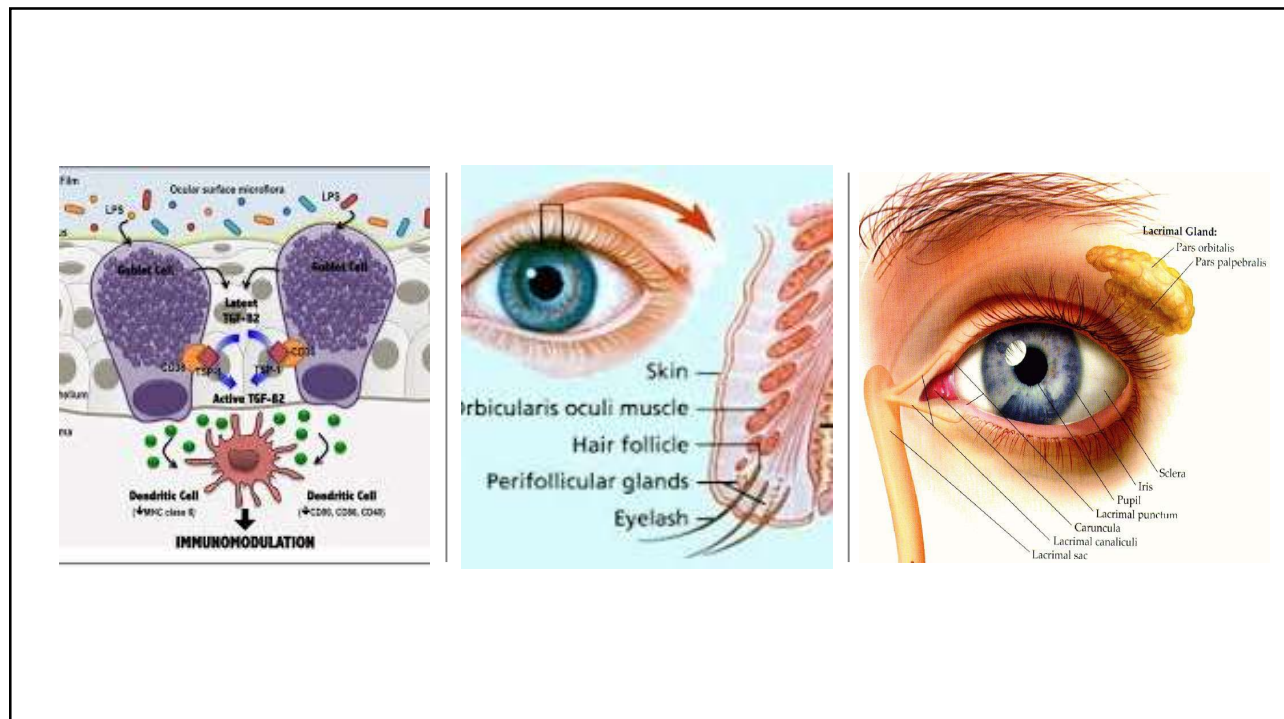
Changes in central corneal  
thickness (CCT)

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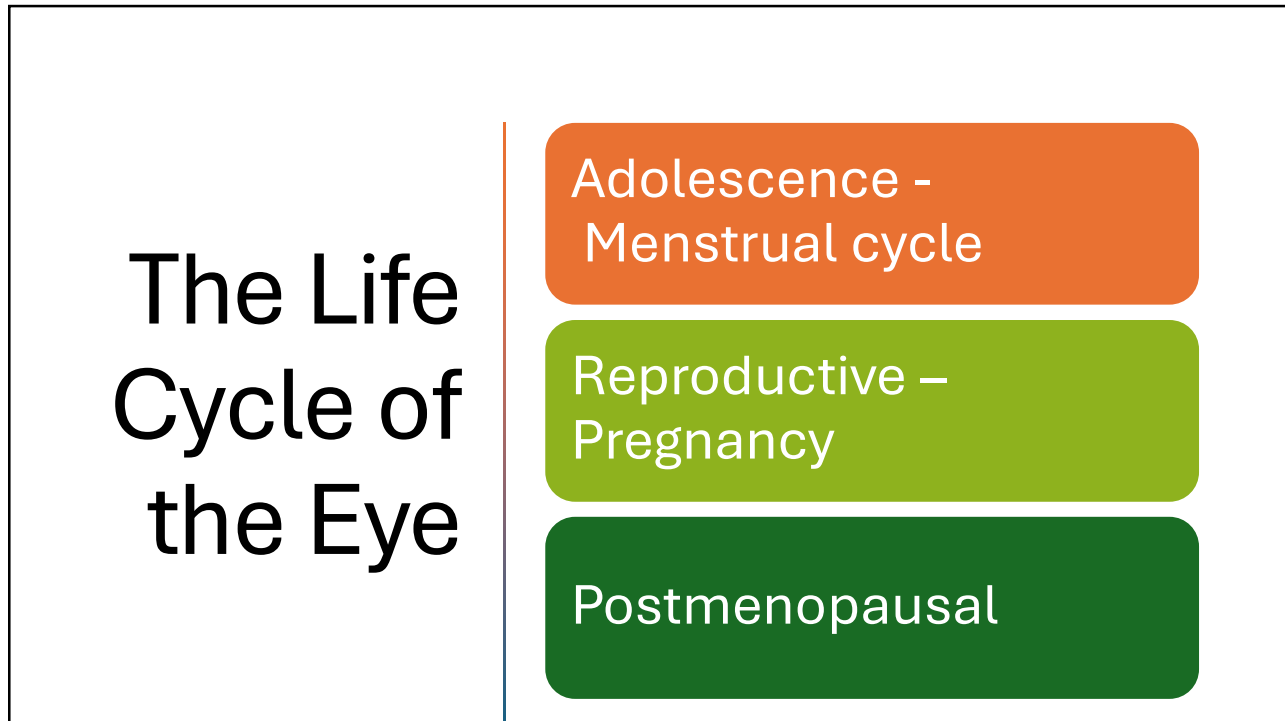
**Measuring tear quantity and quality**

- Mucin - Lissamine green staining of the conjunctiva
- Aqueous - Schirmer's Test (quantity) and Tear Lab (quality)
- Meibum - Tear Break Up Time (TBUT) with fluorescein

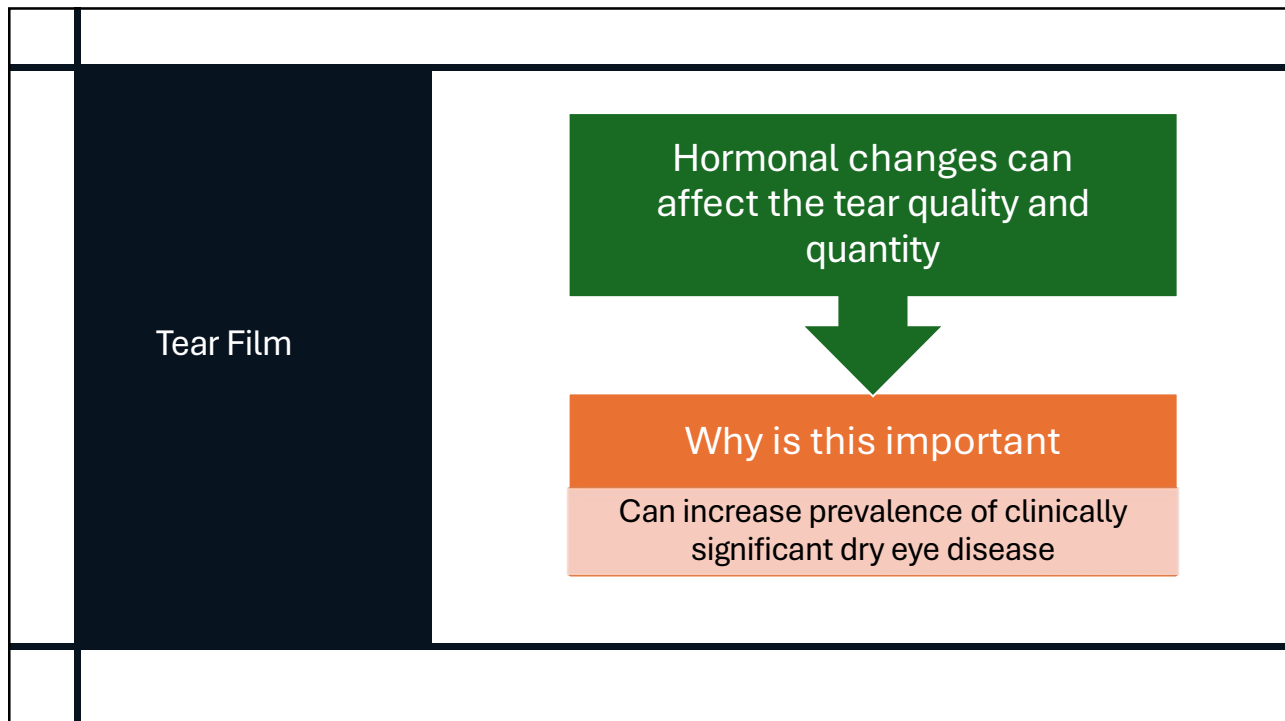
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## Hormones and Ocular Structure and Function

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21



22

## Adolescence - menstrual cycle

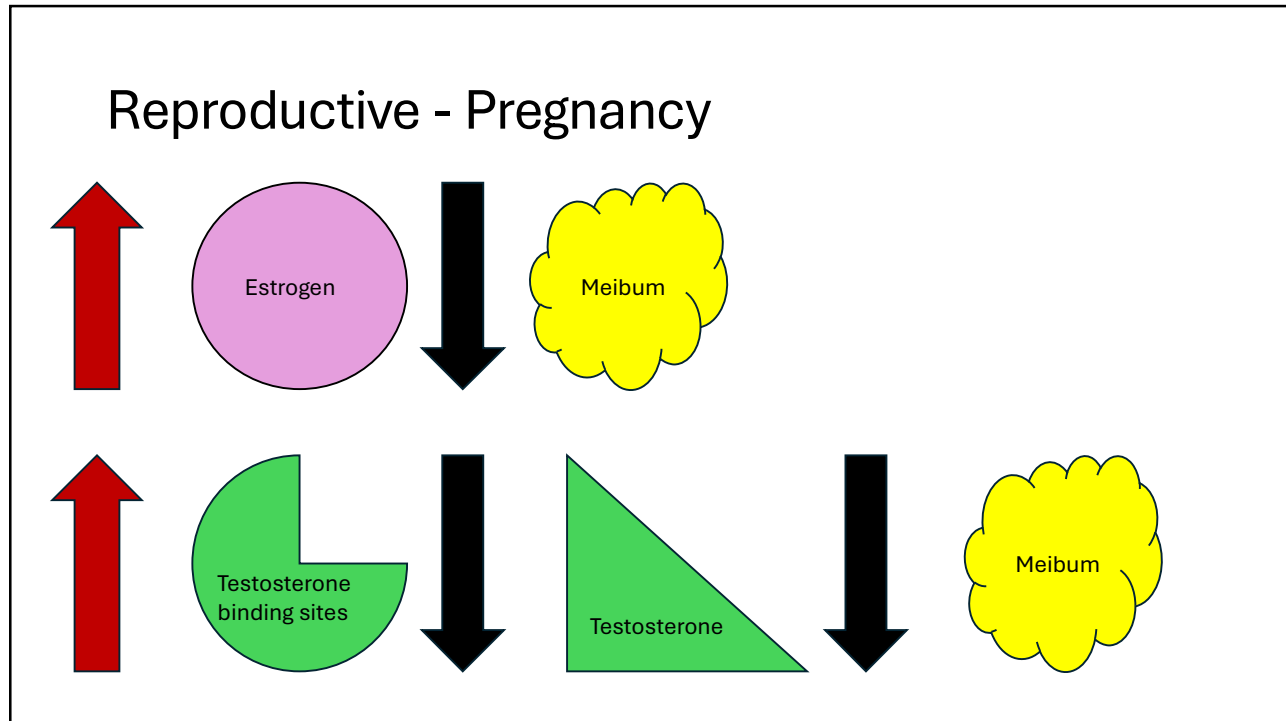
- Follicular phase - increase in luteinizing hormone (LH), follicular stimulating hormone (FSH) and estrogen
- Ovulation - LH and FSH peak
- Kelly et al. Study found no significant change in Tear Break Up Time (TBUT) or Schirmers Test during this phase
- In conclusion LH and FSH have very little effect on the tear film partially explaining why healthy young women generally do not experience clinically significant dry eye.

23

## Reproductive - Pregnancy

- Increase in estrogen, progesterone and relaxin
- Increase in Dry Eye Syndrome (DES)
- Decrease in TBUT
- Kelly et al. Found a significant increase in Ocular Surface Disease Index (OSDI) and a decrease in TBUT. Interestingly, they found an unexplained increase in Schirmer's?
- In conclusion, an increase in estrogen and a decrease in testosterone can increase clinically significant dry eye during pregnancy.

24

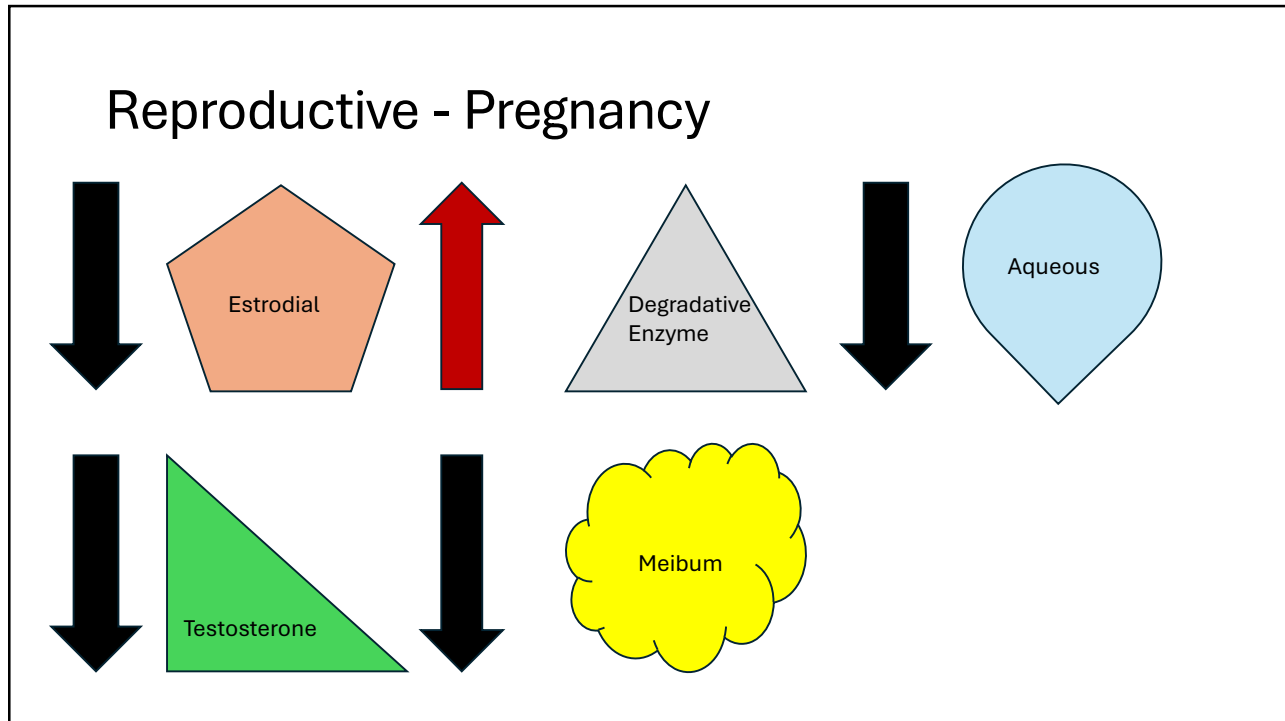


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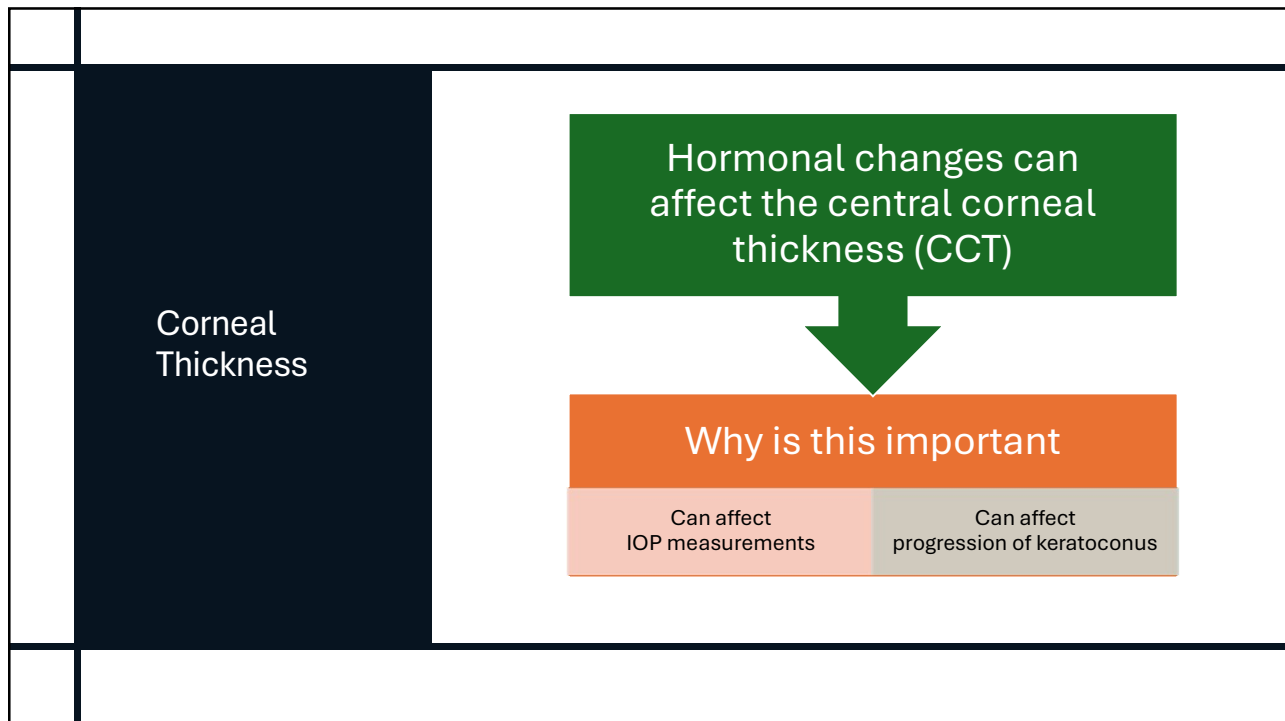
Postmenopausal

- Decrease in estradiol and testosterone
- Increasing DES
- Kelly et al. Found that a decrease in estradiol caused an increase in degradative enzymes toward exocrine glands reducing tear production. As well a decrease in testosterone reducing lipid production
- In conclusion, postmenopausal women experienced high OSDI scores, decreased TBUT and Schirmer's causing clinically significant dry eye.

26



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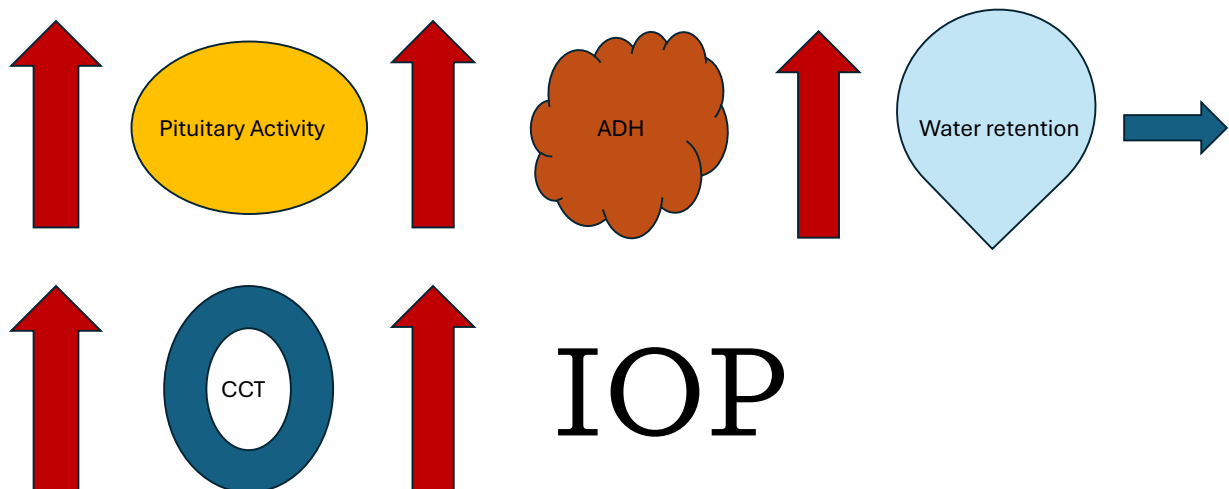
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## Adolescence - Menstrual cycle

- CCT is thinnest at the start of the menstrual cycle and is thickest at ovulation.
- Kelly et al found this could be explained by pituitary hyperactivity during ovulation leads to an increase in antidiuretic hormone (ADH) causing water retention.
- Increase in CCT can cause the APPEARANCE of increase in intraocular pressure (IOP).

29

## Adolescence - menstrual cycle



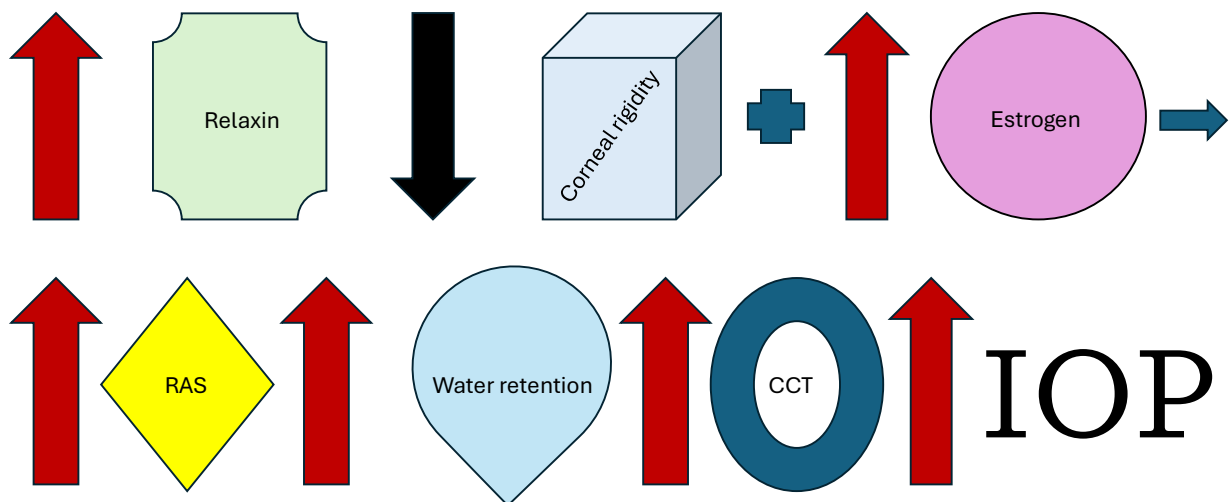
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## Reproductive - Pregnancy

- CCT increases
- Kelly et al found that an increase in relaxin decreased corneoscleral rigidity and an increase in estrogen stimulates the renin-angiotensin system increasing water retention.
- As well and increase in relaxin can cause a decrease in corneal rigidity increasing progression of keratoconus.

31

## Reproductive-pregnancy

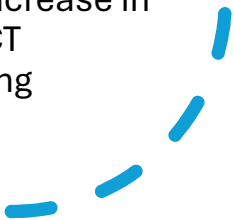


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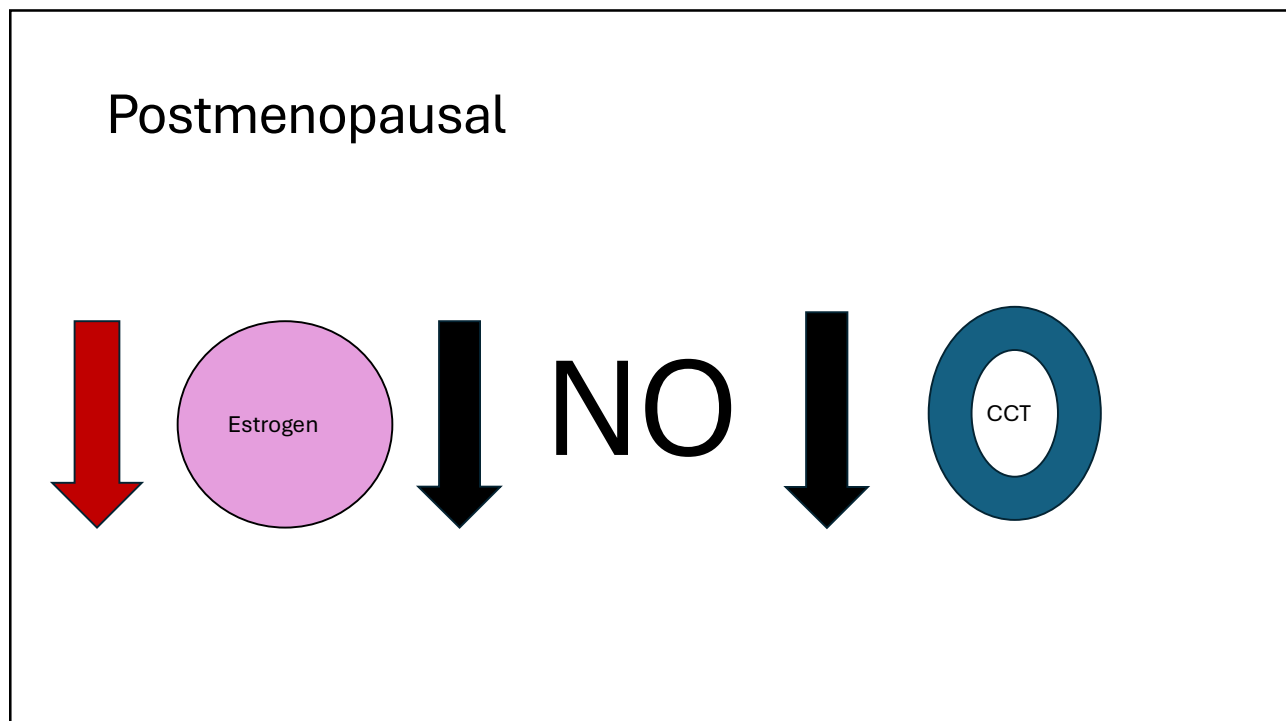


Postmenopausal

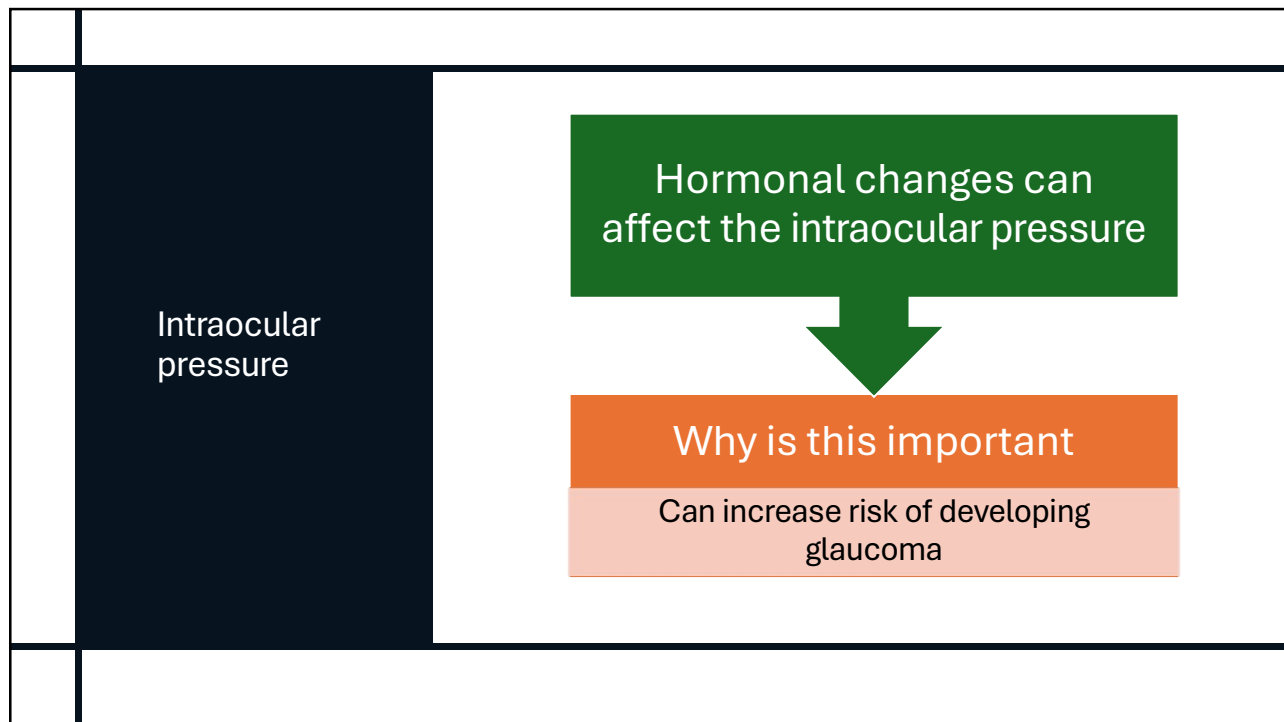
- Decrease in CCT
- Kelly et al found a decrease in estrogen decreased nitric oxide production from the corneal endothelial cells hence decreasing CCT
- Significant dry eye has also been postulated as a cause of the reduction of CCT
- Overall, the study showed an increase in IOP despite the decrease in CCT secondary to other overpowering mechanisms



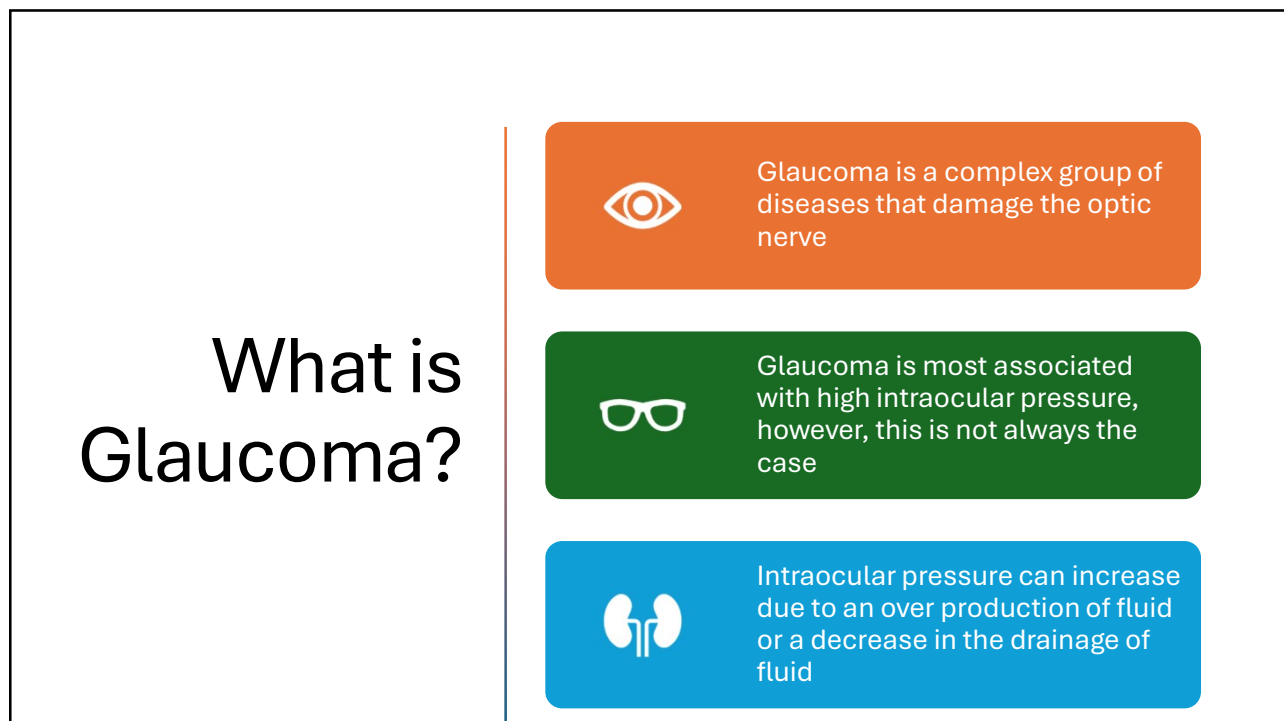
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## Adolescence - Menstrual cycle

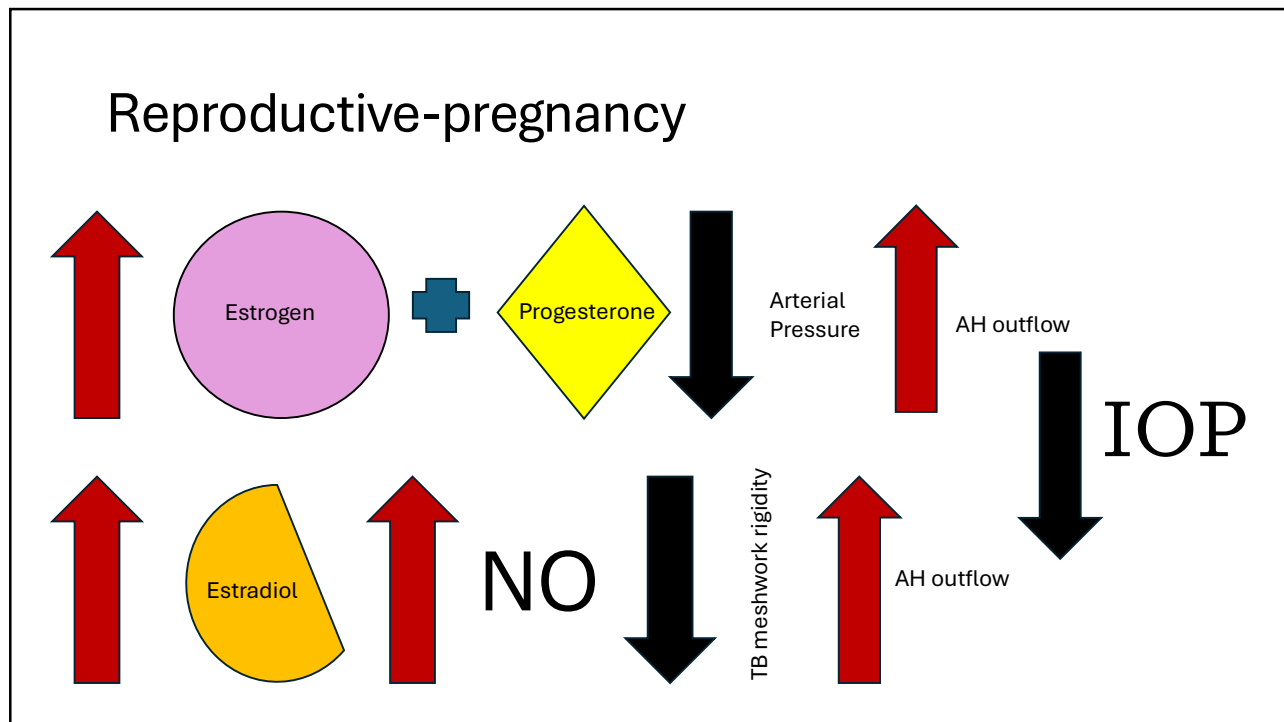
- No significant increase in IOP
- Kelly et al found this could be explained by pituitary hyperactivity during ovulation leads to an increase in antidiuretic hormone (ADH) causing water retention.
- Increase in CCT can cause the APPEARANCE of increase in intraocular pressure (IOP).

37

## Reproductive - Pregnancy

- IOP decreases
- Wang et al., postulated that this was due to an increase in aqueous humor (AH) outflow
- It is thought that an increase in progesterone and estrogen decrease arterial pressure reducing AH production and increasing AH outflow by reducing episcleral venous pressure.
- As well as an increase in estradiol increases nitric oxide. Nitric oxide reduces the rigidity of the trabecular meshwork increasing AH outflow

38

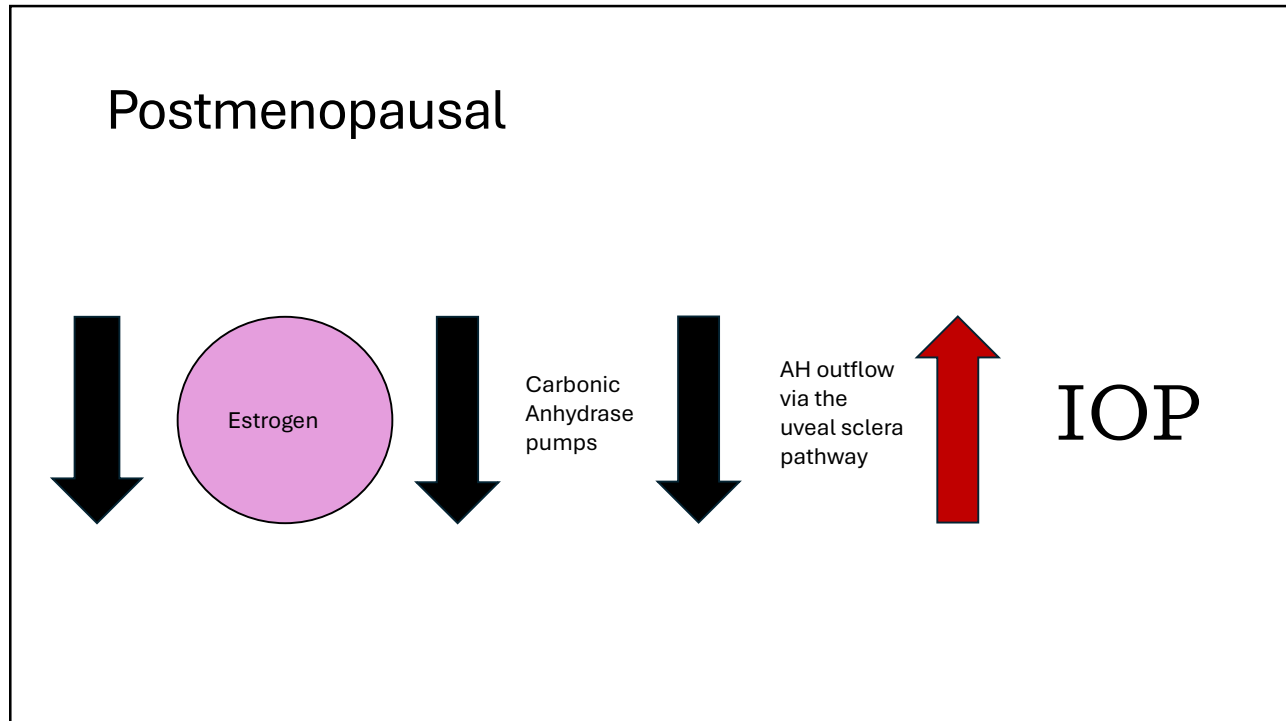


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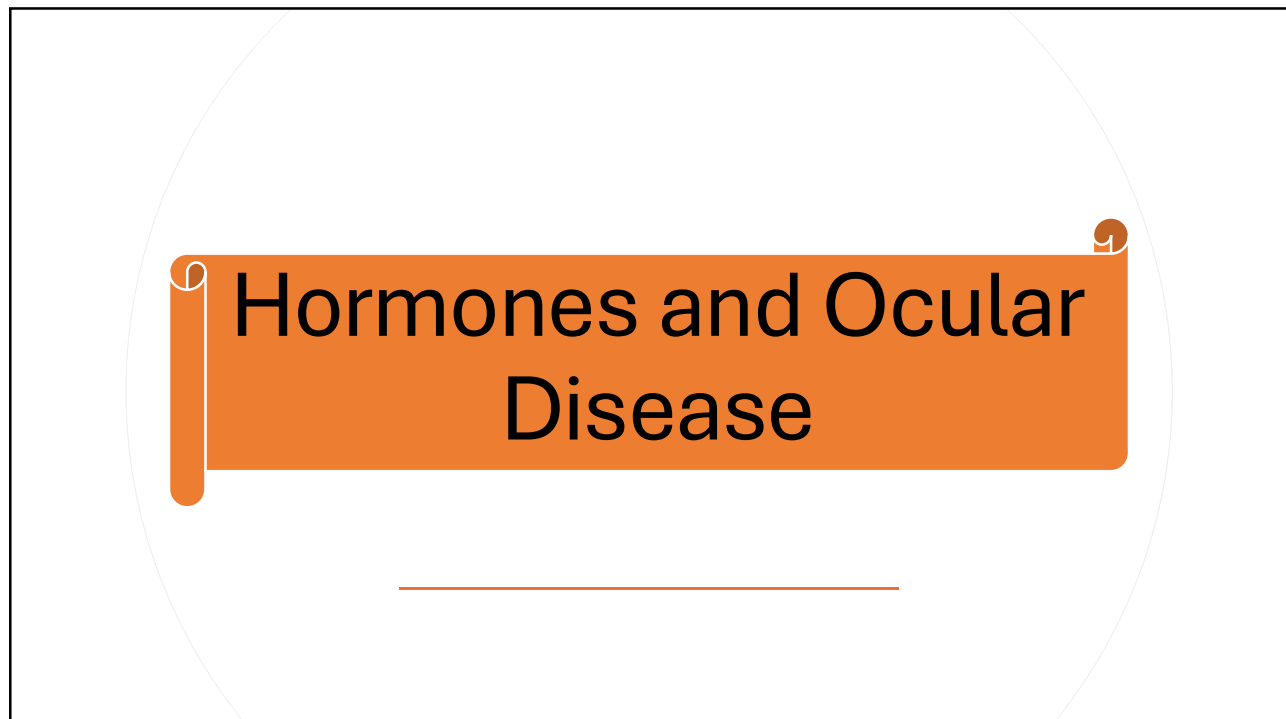
## Postmenopausal

- Increase in IOP
- Birgul et al., found that a decrease in estrogen reduced the function of carbonic anhydrase pumps hence decreasing AH outflow via the uveal sclera pathway
- This could explain the increase in glaucoma in older women

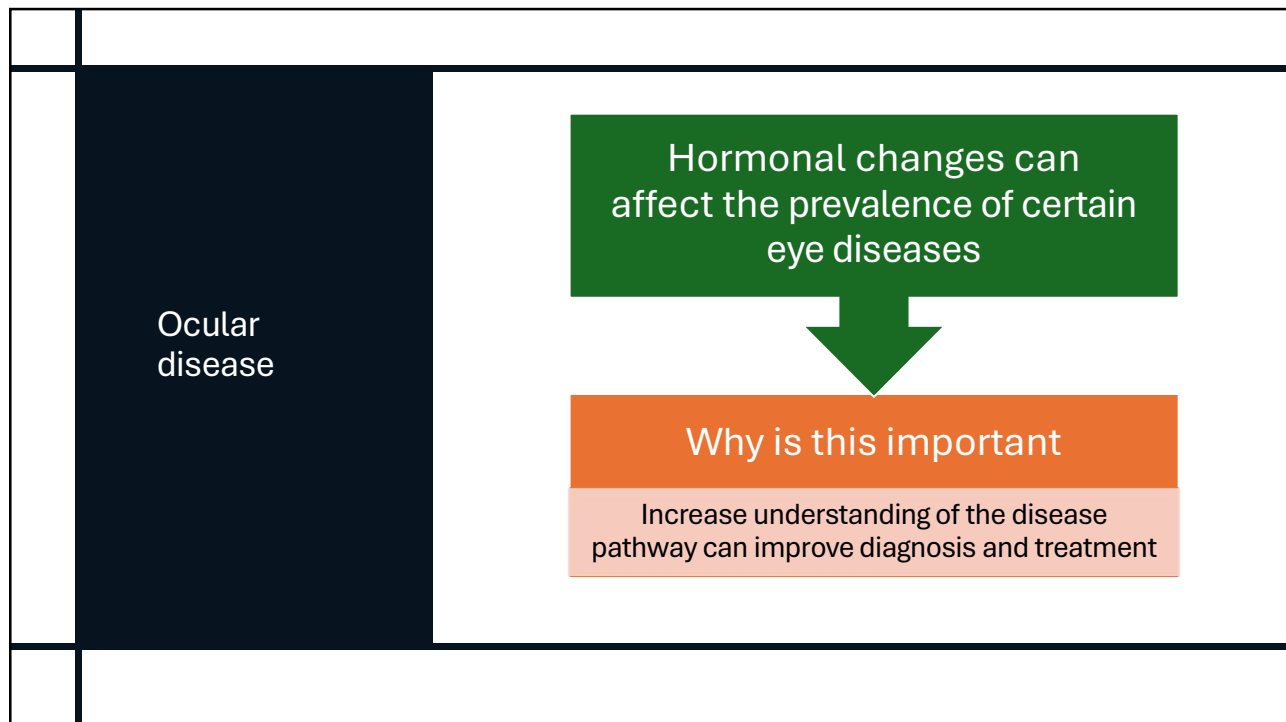
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41



42



43

Dry Eye Disease

- Nuzzi and Caselgrandi found:
- Very high correlation with sex hormones
- Specifically, Androgens and Estrogens

44

## Dry Eye Disease



Decrease in aqueous production  
reducing the quantity of tears



Increase in meibomian gland  
dysfunction decreasing quality of tears

45

### Symptoms of dry eye disease

- Excessive tearing (epiphora)
- Stinging or Burning
- Redness
- Blurry vision
- Foreign body sensation
- Pain

46

## Treatment for dry eye disease



Lubrication - increasing aqueous and/or oil (Artificial Tears/Gels/Ointments and autologous tears)



Warm compresses - decreases oil viscosity and increase excretion of oil (Bruder mask, lipiflow)



Medications – increase aqueous production and/or decrease inflammation (Restasis, Cequal, Xiidra, Tyrvaya and topical steroids)



Environmental – reducing external irritants (wind, allergens, computer use, fans, dusty conditions etc)

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48



## Corneal Disease

- Nuzzi and Caselgrandi found:
- Very high correlation with sex hormones
- Specifically, Estrogens
- Keratoconus

49

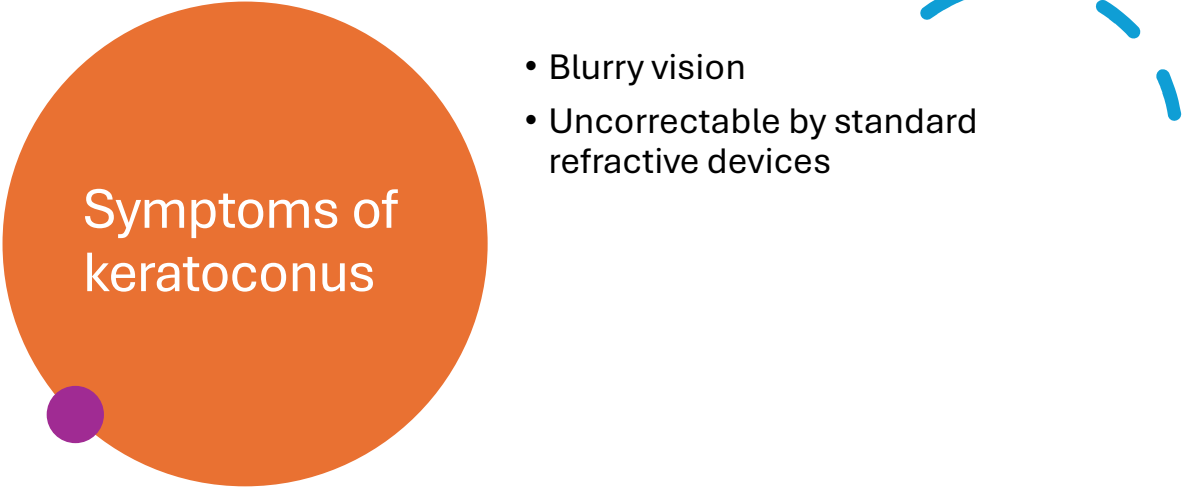
## Keratoconus



Progressive thinning of the cornea  
(ectasia)



50



## Symptoms of keratoconus

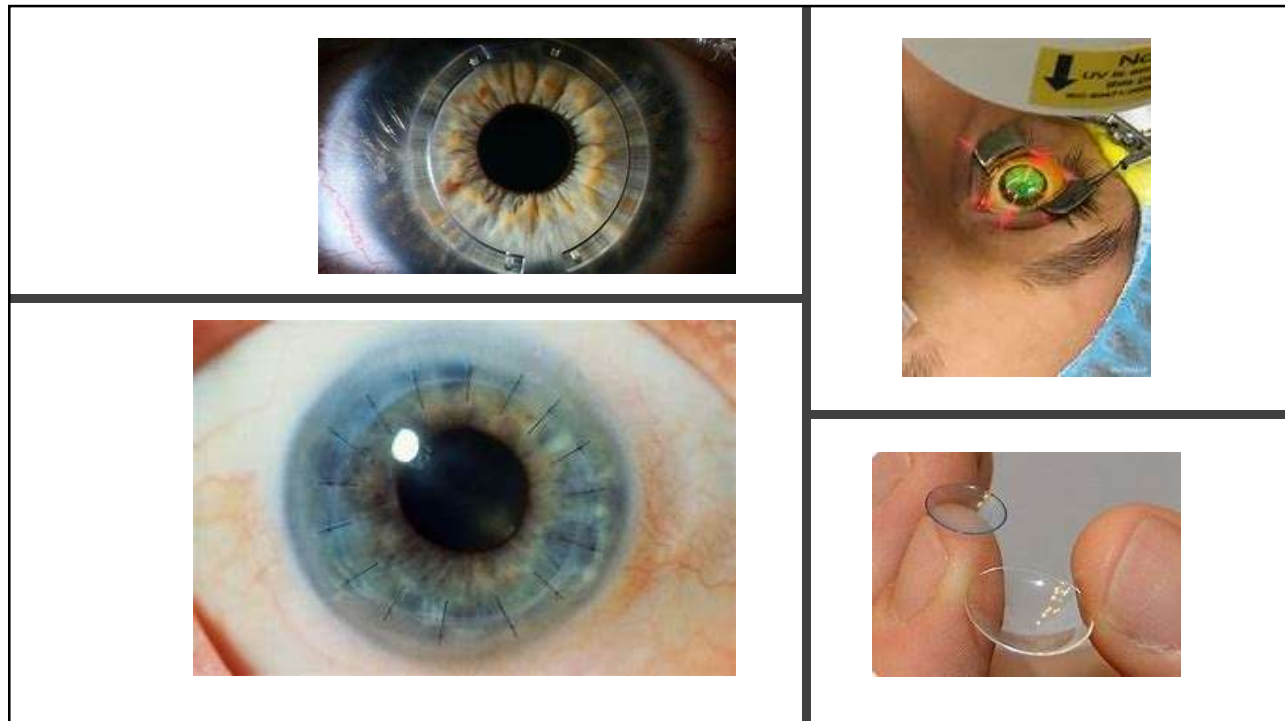
- Blurry vision
- Uncorrectable by standard refractive devices

51

## Treatment for keratoconus

- Custom designed rigid contact lenses (Rose K and scleral lenses)
- Corneal crosslinking (UV light that increases the rigidity of the collagen fibers in the cornea)
- Intacs (implanted plastic ring in the cornea to flat the cone)
- Corneal transplant

52



53

## Cataract

- Nuzzi and Caselgrandi found:
- Mild correlation with sex hormones
- Specifically, Estrogens
- Estrogen has antioxidant properties that protect the lens from oxidative stress

54

## Cataract



Increased incidence in women



Increased incidence in  
postmenopausal women

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### Symptoms of cataract

- Blurry vision
- Glare
- Difficulty driving at night
- Increased need for light to read
- Uncorrectable by standard refractive devices

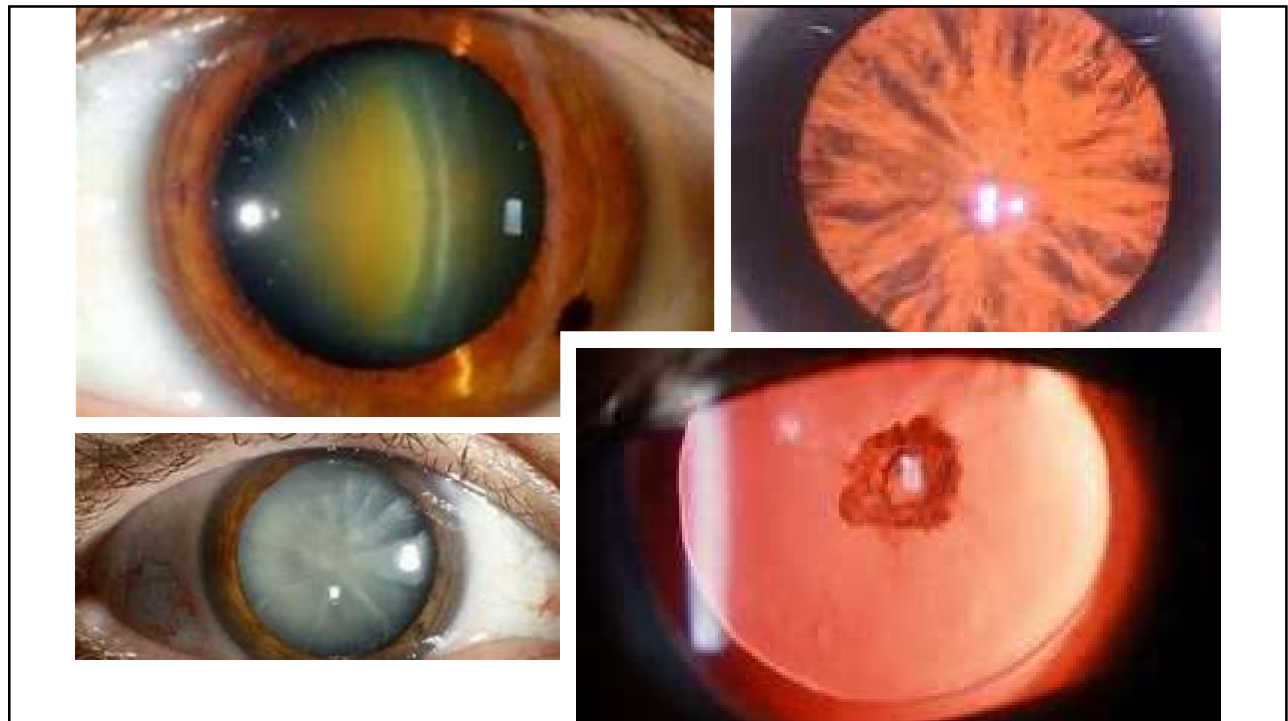
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## Treatment for cataract

### Cataract surgery

- Removal of the crystalline lens
- Replaced with an artificial lens (IOL)

57



58



59

## Glaucoma

- Nuzzi and Caselgrandi found:
- Mild correlation with sex hormones
- Specifically, Estrogens
- Estrogen is thought to be neuroprotective
- Decrease in estrogen increase IOP discussed earlier

60

## Glaucoma



Affect women more than men

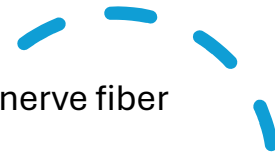


Affects older population more than younger

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### Symptoms of Glaucoma

- Thinning of the retinal nerve fiber layer
- Loss of peripheral vision



62

## Treatment for Glaucoma

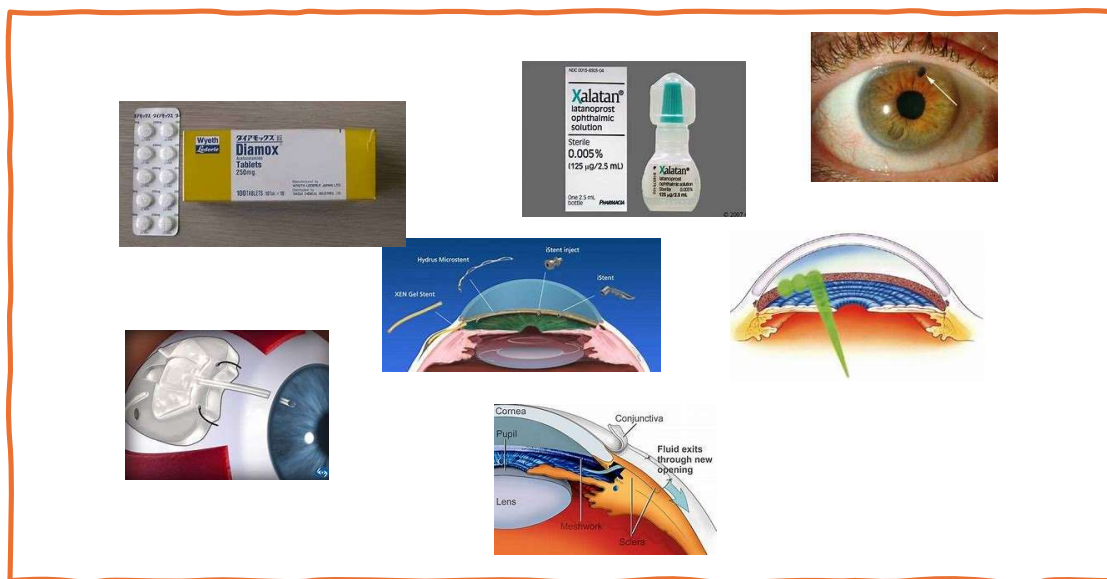
Medication – drops and/or orals (Prostaglandins, BB, AA, CAI and myotics)

Laser – LPI, SLT and ALT

MIGs - stents

Surgery – Trab and tubes

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64



## Leber's hereditary optic neuropathy (LHON)

- Nuzzi and Caselgrandi found:
- Very high correlation with sex hormones
- Specifically, Estrogens

65

## LHON

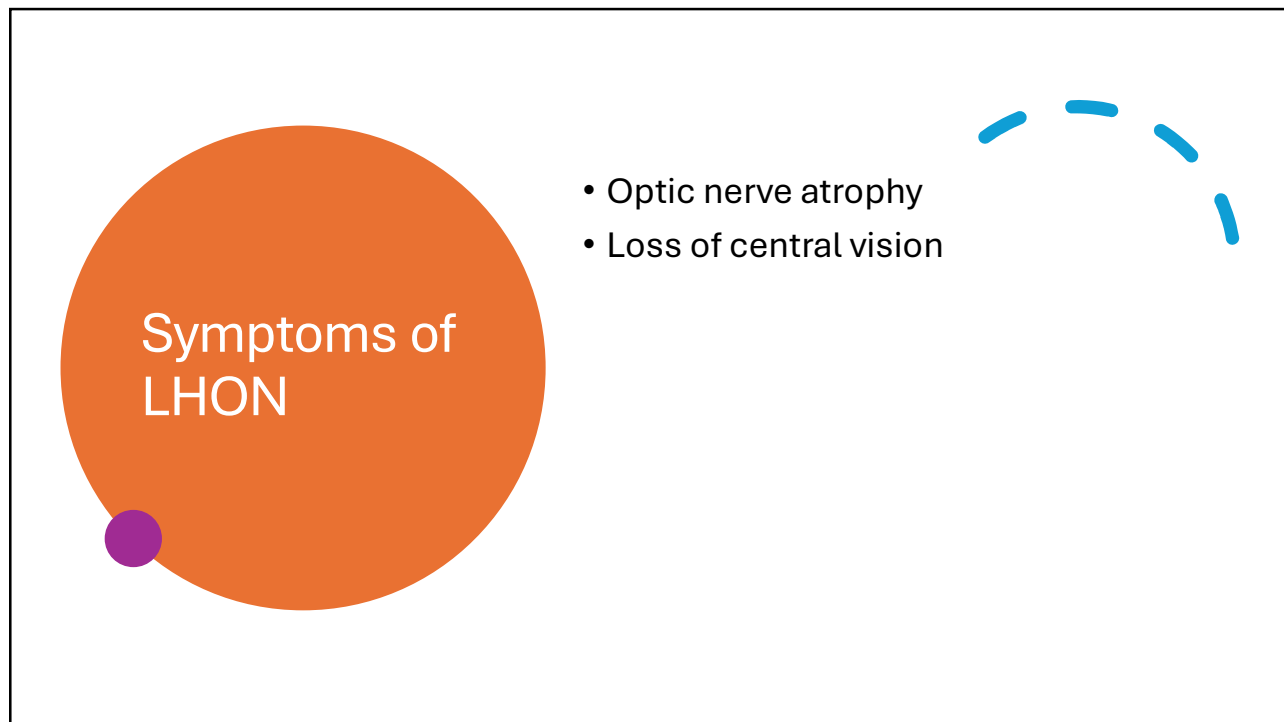


LHON affects young men far more than women



Estrogen is thought to be neuroprotective against LHON

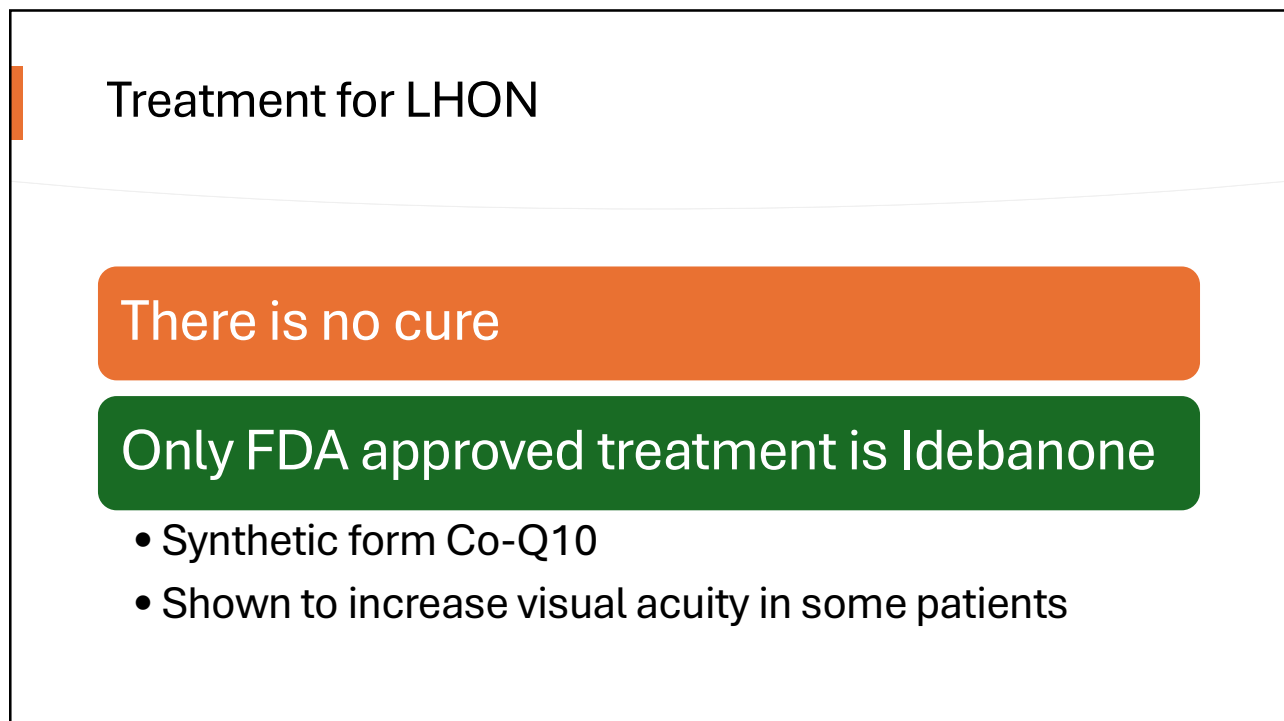
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Symptoms of LHON

- Optic nerve atrophy
- Loss of central vision

67



## Treatment for LHON

There is no cure

Only FDA approved treatment is Idebanone

- Synthetic form Co-Q10
- Shown to increase visual acuity in some patients

68

## Some other condition being studied

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Optic neuritis - Estrogen, Progesterone and Androgens (high estrogen promotes remyelination, Progesterone protect against demyelination and Androgens promote myelin production)

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Age-related macular degeneration – Estrogen (not a lot of studies yet)

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Central serous chorioretinopathy – Estrogen is protective? Much higher incidence in men

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Retinitis pigmentosa – progesterone is protective?

69

## Questions being asked

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Will Hormone replacement therapies be effective in reducing the risk of these diseases?

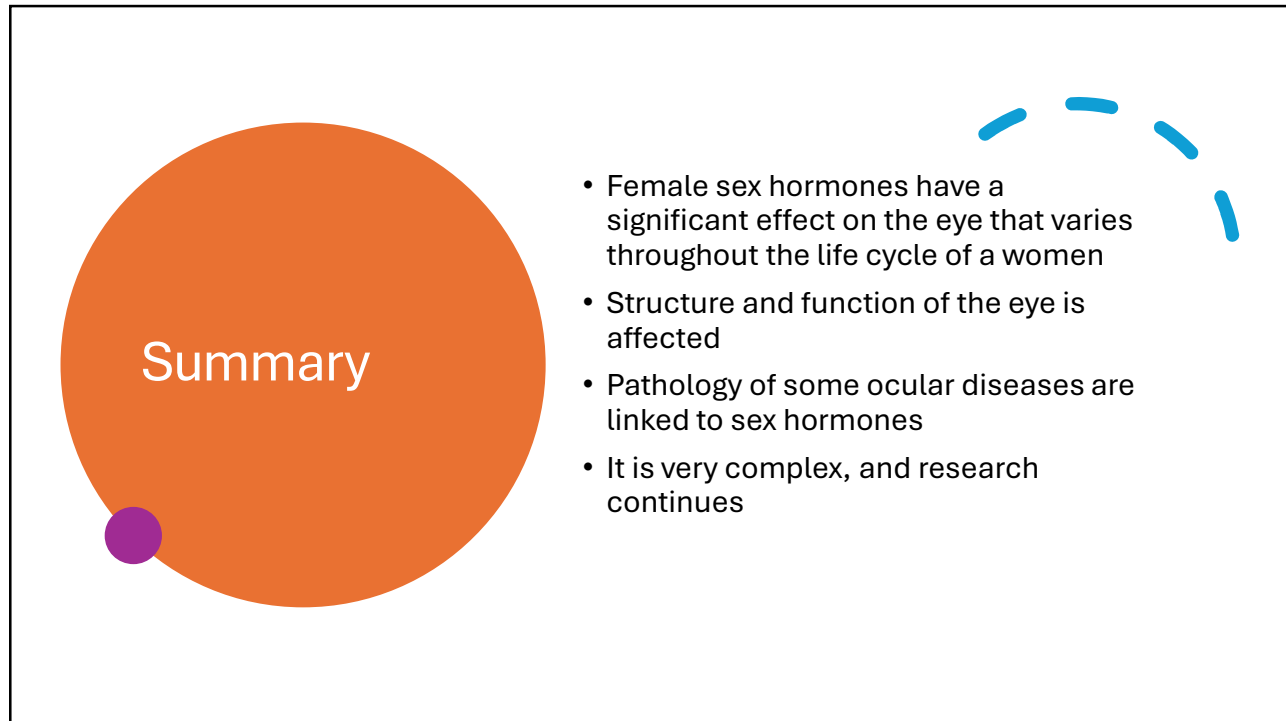


Chao et al., suggests that they may but more research needs to be done



A dry eye study was done by Chao et al., but the findings were inconclusive

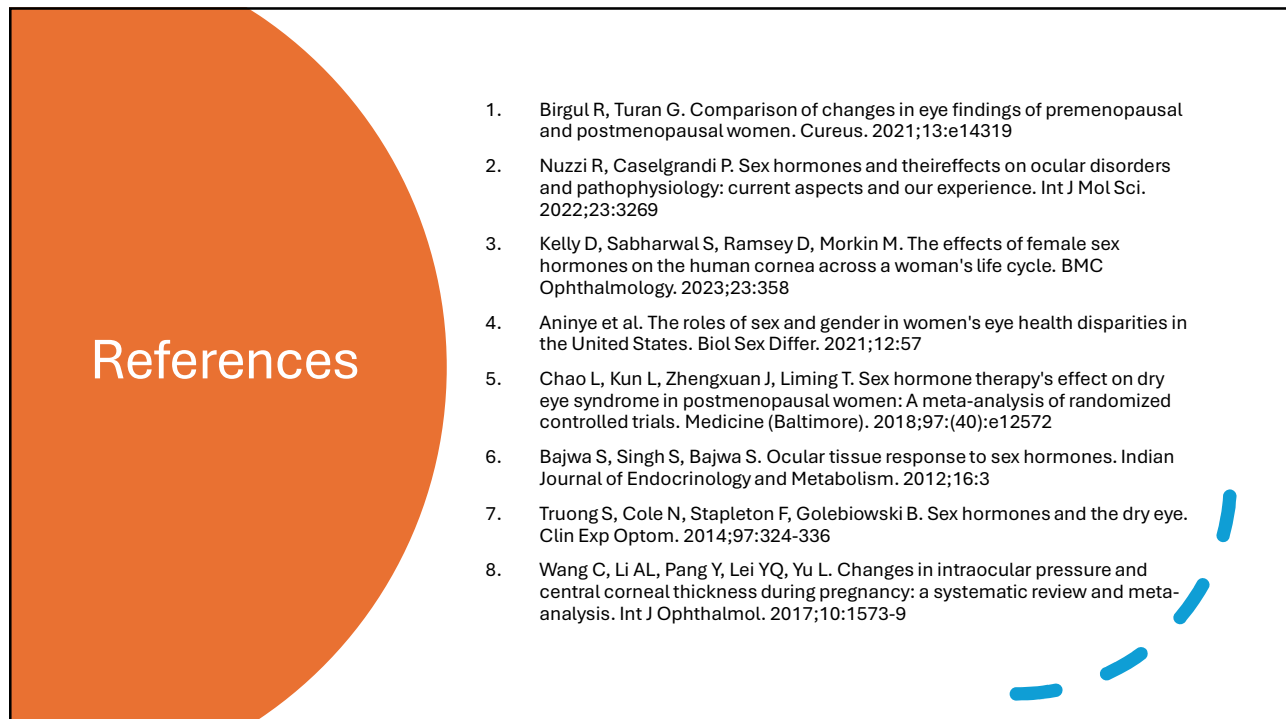
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## Summary

- Female sex hormones have a significant effect on the eye that varies throughout the life cycle of a women
- Structure and function of the eye is affected
- Pathology of some ocular diseases are linked to sex hormones
- It is very complex, and research continues

71



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72

