Lens measurements

- Birth: # mm equatorial, # mm anteroposterior
Lens measurements

- Birth: 6.4 mm equatorial, 3.5 mm anteroposterior
Lens Measurements

- **Birth**: 6.4 mm equatorial, 3.5 mm anteroposterior
- **Adult**: # to # mm equatorial, # mm anteroposterior
Lens Measurements

- **Lens measurements**
  - Birth: **6.4** mm equatorial, **3.5** mm anteroposterior
  - Adult: **9-10** mm equatorial, **5.0** mm anteroposterior
Lens measurements
- Birth: 6.4 mm equatorial, 3.5 mm anteroposterior
- Adult: 9-10 mm equatorial, 5.0 mm anteroposterior

Cataract surgeons will sometimes employ an age-based rule of thumb for guesstimating the A-P depth of a lens—what is it?
Lens measurements

- Birth: 6.4 mm equatorial, 3.5 mm anteroposterior
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Cataract surgeons will sometimes employ an age-based rule of thumb for guesstimating the A-P depth of a lens—what is it? A-P depth = ‘Four (point) pt age’ (eg, the A-P depth of the lens in a 65 y.o. is ~4.65 mm)
Lens Measurements

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\[
\text{A-P depth} = \text{‘Four (point) pt age’} \\
\text{(e.g., the A-P depth of the lens in a 65 y.o. is \sim 4.65 mm)}
\]

The fact that the magnitude of this number correlates with age implies that the lens never stops getting thicker. Is this the case?
Lens Measurements

- **Birth**: 6.4 mm equatorial, 3.5 mm anteroposterior
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It is indeed
Lens Measurements

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Cataract surgeons will sometimes employ an age-based rule of thumb for estimating the A-P depth of a lens—what is it? (e.g., the A-P depth of the lens in a 65 y.o. is ~4.65 mm)

A-P depth = ‘Four (point) pt age’

The fact that the magnitude of this number correlates with age implies that the lens never stops getting thicker. Is this the case? It is indeed.

What is the cause of this thickening? That is, does it result from enlargement of existing cells/structures, or the creation of new cells (i.e., replication)?
Lens measurements

- Birth: 6.4 mm equatorial, 3.5 mm anteroposterior
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It’s both—but it must be stressed that replication is the driving force.
Lens Measurements

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Which cells are doing the replicating?

Replication is the driving force.
Lens measurements

- Birth: 6.4 mm equatorial, 3.5 mm anteroposterior
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Which cells are doing the replicating?
The lens epithelial cells (these are the only cells in the lens that are mitotically active)

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Where are the lens epithelial cells found?

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Which cells are doing the replicating?
The lens epithelial cells (these are the only cells in the lens that are mitotically active)

Where are the lens epithelial cells found?
They line the inner aspect of the anterior capsule all the way out to the equatorial region. They are cuboidal in shape, and arranged in a single-layered fashion.

Are they all mitotically active?
Yes, but those located in the germinative zone (GZ) are particularly so. The ring-shaped GZ is located in the peripheral aspect of the anterior capsule. After their creation, newly-minted GZ epi cells migrate to the so-called bow region of the equatorial lens. It is in the bow region that these cells begin the process of terminal differentiation into lens fibers, including loss of organelles and elongation. It is the continual addition of these fibers that is responsible for the nonstop A-P thickening of the lens.

replication is the driving force
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Where are the lens epithelial cells found?
They line the inner aspect of the anterior capsule

replication is the driving force.
Q

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*eg, the A-P depth of the lens in a 65 y.o. is ~4.65 mm*

Which cells are doing the replicating?
The lens epithelial cells (these are the only cells in the lens that are mitotically active)

Where are the lens epithelial cells found?
They line the inner aspect of the anterior capsule **all the way out to the equatorial region**. They are in shape

- **squamous?**
- **columnar?**
- **cuboidal?**

Which of existing cells/structures, or the creation of new cells (i.e., replication)?
It's both—but it must be stressed that **replication is the driving force**.
Lens Measurements

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Which cells are doing the replicating? Why?
Replication is the driving force.

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Replication is the driving force.

Peripheral v central
Lens Measurements

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Why is replication the driving force of lens thickening?
It's both—but it must be stressed that replication is the driving force.
Lens Measurements

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Replication is the driving force.
Lens Measurements

Lens epi cells and their relation to the capsule, GZ, and bow region
Lens Measurements

- Lens measurements
  - Birth: 6.4 mm equatorial, 3.5 mm anteroposterior
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Are they all mitotically active?
Yes, but those located in the germinative zone located in the peripheral aspect of the lens migrate to the so-called bow region of the equatorial lens. After their creation, newly-minted GZ epi cells begin the process of terminal differentiation into lens fibers, including loss of organelles and elongation. It is the continual addition of these fibers that is responsible for the nonstop A-P thickening of the lens. Is this pronounced ‘bow’ as in ‘bow tie,’ or bow as in ‘take a bow’?

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replication is the driving force.
A

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Is this pronounced ‘bow’ as in ‘bow tie,’ or bow as in ‘take a bow’?
It’s pronounced ‘bow’ as in ‘the bow of a ship’ (which is what it looks like in cross-section; look back at the Figure).

replication is the driving force
Lens Measurements

- **Lens measurements**
  - Birth: **6.4** mm equatorial, **3.5** mm anteroposterior
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- **With age…**
  - Lens curvature (increases vs decreases) → ↑ or ↓ refractive power
Lens Measurements

- Lens measurements
  - Birth: 6.4 mm equatorial, 3.5 mm anteroposterior
  - Adult: 9-10 mm equatorial, 5.0 mm anteroposterior
- With age…
  - Lens curvature increases $\rightarrow$ ↑ refractive power
Lens measurements

- **Birth:** 6.4 mm equatorial, 3.5 mm anteroposterior
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With age...

- Lens curvature **increases** \( \rightarrow \uparrow \text{ refractive power} \)
- Refractive index \( \text{increases vs decreases} \) \( \rightarrow \uparrow \text{ or } \downarrow \text{ refractive power} \)
Lens Measurements

- **Lens measurements**
  - Birth: **6.4** mm equatorial, **3.5** mm anteroposterior
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- **With age…**
  - Lens curvature **increases** → ↑ refractive power
  - Refractive index **decreases** → ↓ refractive power
Lens Measurements

- Lens measurements
  - Birth: 6.4 mm equatorial, 3.5 mm anteroposterior
  - Adult: 9-10 mm equatorial, 5.0 mm anteroposterior

With age...

- Lens curvature increases $\rightarrow$ $\uparrow$ refractive power
- Refractive index decreases $\rightarrow$ $\downarrow$ refractive power

So which do people become with age—more myopic or more hyperopic?
Lens Measurements

- **Lens measurements**
  - Birth: 6.4 mm equatorial, 3.5 mm anteroposterior
  - Adult: 9-10 mm equatorial, 5.0 mm anteroposterior

- **With age…**
  - Lens curvature *increases* → ↑ refractive power
  - Refractive index *decreases* → ↓ refractive power

So which do people become with age—more myopic or more hyperopic? As the change in an individual’s refraction is a function of the interplay between these, it can be either
**Lens Measurements**

**Lens capsule thickness: Fill in the blanks**

**Anterior**

? \( \mu \text{m} \)

**Posterior**

}\( \mu \text{m} \)

}\( \mu \text{m} \)

}\( \mu \text{m} \)

}\( \mu \text{m} \)
**Q/A**

**Lens Measurements**

*Lens capsule thickness: Fill in the blanks*

![Diagram of lens measurements with question marks to be filled in](image-url)
Lens capsule thickness: Fill in the blanks

Anterior:
- 14 µm

Posterior:
- 21 µm
- 7 µm
- 14 µm
- 21 µm
- 7 µm
- 14 µm
Lens Measurements

Lens capsule thickness: Fill in the blanks

Anterior

14 µm

21 µm

17 µm

Posterior

? µm

? µm

? µm

Q/A
Q/AN antenna subtype

Lens Measurements

Lens capsule thickness: Fill in the blanks

Anterior

14 µm

Posterior

21 µm

17 µm

23 µm

? µm
Lens Measurements

Lens capsule thickness: Fill in the blanks

Anterior

14 μm

21 μm

23 μm

4 μm

Posterior

17 μm
At 4 µm, the posterior capsule is so thin it is always distended. Thus, all changes in lens shape during accommodation occur at the anterior capsule.
At 4 µm, the posterior capsule is so thin it is always distended. Thus, all changes in lens shape during accommodation occur at the anterior capsule.

**Lens Measurements**

Lens capsule thickness: Fill in the blanks

- **Anterior**
  - **14 µm**
  - **21 µm**
  - **23 µm**
- **Posterior**
  - **4 µm**
  - **17 µm**

No question—proceed when ready
The lens of a 25-year-old woman demonstrated by Scheimpflug photography. The lens is in the nonaccommodative state in A, and accommodating in B.
At 4 µm, the posterior capsule is so thin it is always distended. Thus, all changes in lens shape during accommodation occur at the anterior capsule?

It was noted a few slides ago that lens curvature increases with age. Does this occur at the anterior capsule as well?
At 4 µm, the posterior capsule is so thin it is always distended. Thus, all changes in lens shape during accommodation occur at the anterior capsule?

**Lens Measurements**

**Lens capsule thickness: Fill in the blanks**

It was noted a few slides ago that lens curvature increases with age. Does this occur at the anterior capsule as well? It does indeed, and for the same reason that changes in accommodative status occur there.
The lens of a 25-year-old woman demonstrated by Scheimpflug photography. The lens is in the nonaccommodative state in A, and accommodating in B. Note that the anterior radius of curvature is shortened in the latter case.
Zonules

- Embryologically, the vitreous

Lens Measurements

$1^\circ \text{ vs } 2^\circ \text{ vs } 3^\circ$
Lens Measurements

- Zonules
  - Embryologically, the tertiary vitreous
● Zonules
  ● Embryologically, the **tertiary vitreous**
  ● Originate from the very specific tissue of the pigmented vs nonpigmented epithelium of the specific portion 1 and specific portion 2 of the ciliary body
Zonules

- Embryologically, the *tertiary vitreous*
- Originate from the *basal lamina* of the *nonpigmented epithelium* of the *pars plana* and *pars plicata* of the ciliary body
Lens Measurements

(Nevra you mind what these are pointing to)
Zonules

Embryologically, the **tertiary vitreous**

Originate from the **basal lamina** of the **nonpigmented** epithelium of the **pars plana** and **pars plicata** of the ciliary body

Three sets of fibers:
1) ?
2) ?
3) ?
Zonules

Embryologically, the tertiary vitreous

Originate from the basal lamina of the nonpigmented epithelium of the pars plana and pars plicata of the ciliary body

Three sets of fibers:
1) Equatorial
2) Anterior
3) Posterior
Zonular insertions on the lens
Zonules

- Embryologically, the **tertiary vitreous**
- Originate from the **basal lamina** of the **nonpigmented** epithelium of the **pars plana** and **pars plicata** of the ciliary body

- Three sets of fibers:
  1) **Equatorial**: Insert at the **same location** (duh)
  2) Anterior
  3) Posterior
Zonules

- Embryologically, the *tertiary vitreous*
- Originate from the *basal lamina* of the *nonpigmented epithelium* of the *pars plana* and *pars plicata* of the ciliary body
- Three sets of fibers:
  1. *Equatorial*: Insert at the *equator* (duh)
  2. Anterior
  3. Posterior
Lens Measurements

Zonules

- Embryologically, the *tertiary* vitreous
- Originate from the basal lamina of the nonpigmented epithelium of the pars plana and pars plicata of the ciliary body
- Three sets of fibers:
  1) *Equatorial*: Insert at the equator (duh)
     - These zonules regress with age
  2) Anterior
  3) Posterior
Zonules

Embryologically, the **tertiary vitreous**

Originate from the **basal lamina** of the **nonpigmented** epithelium of the **pars plana** and **pars plicata** of the ciliary body

Three sets of fibers:

1) **Equatorial**: Insert at the **equator** (duh)
   - These zonules **regress** with age

2) **Anterior**

3) **Posterior**
Zonules

Embryologically, the **tertiary vitreous** originate from the basal lamina of the nonpigmented epithelium of the pars plana and pars plicata of the ciliary body.

Three sets of fibers:

1) **Equatorial**: Insert at the equator (duh)
   - These zonules **regress** with age

2) **Anterior**: Insert ___mm anterior to equator

3) **Posterior**
A

● Zonules
  ● Embryologically, the **tertiary vitreous**
  ● Originate from the basal lamina of the nonpigmented epithelium of the pars plana and pars plicata of the ciliary body
  ● Three sets of fibers:
    1) **Equatorial**: Insert at the equator (duh)
       - These zonules regress with age
    2) **Anterior**: Insert 1.5 mm anterior to equator
    3) **Posterior**
Zonules

Embryologically, the **tertiary vitreous** originate from the basal lamina of the nonpigmented epithelium of the pars plana and pars plicata of the ciliary body.

Three sets of fibers:

1. **Equatorial**: Insert at the equator (duh)
   - These zonules regress with age

2. **Anterior**: Insert 1.5 mm anterior to equator

3. **Posterior**: Insert _____ mm posterior to equator
Zonules

Embryologically, the tertiary vitreous originate from the basal lamina of the nonpigmented epithelium of the pars plana and pars plicata of the ciliary body.

Three sets of fibers:
1) Equatorial: Insert at the equator (duh)
   - These zonules regress with age
2) Anterior: Insert 1.5 mm anterior to equator
3) Posterior: Insert 1.25 mm posterior to equator
Zonules

- Embryologically, the tertiary vitreous
- Originate from the basal lamina of the nonpigmented epithelium of the pars plana and pars plicata of the ciliary body
- Three sets of fibers:
  1) **Equatorial**: Insert at the equator (duh)
  2) **Anterior**: Insert 1.5 mm anterior to equator
  3) **Posterior**: Insert 1.25 mm posterior to equator

**Lens Measurements**

- Probably more important to remember the relative insertions of the anterior and posterior zonules rather than the specific distances

2) **Anterior**: Insert more centrally than the posterior
3) **Posterior**: Insert less centrally than the anterior
Same figure as a few slides ago, but this time note the relative locations of the insertions of the anterior vs posterior zonules.
What are the three lens/cataract layers as encountered in cataract surgery?
What are the three lens/cataract layers as encountered in cataract surgery?

- Nucleus
- Epinucleus
- Cortex
Lens Measurements

Surgical

Layers of the lens:

- lens capsule
- cortex
- epinucleus
- inner nucleus

(aka the endonucleus aka jes plain ol’ nucleus)
What are the three lens/cataract layers as encountered in cataract surgery? How do these layers differ from one another histologically?

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*Trick question—they don’t!* These terms refer to differences in appearance and behavior of lens material encountered during cataract surgery. They are descriptive terms, not histological.
What are the three lens/cataract layers as encountered in cataract surgery?

Briefly, how does each layer look and behave during cataract surgery?

Nucleus:
Opaque, usually with an amber hue. The nucleus is firm, and cannot be aspirated from the eye until/unless it is broken up (emulsified, hence the term phacoemulsification).

Epinucleus:
Clear to cloudy. The epinucleus is soft, and can be aspirated without emulsification (although emulsifying energy is often employed during epinucleus removal in order to make the process faster/more efficient).

Cortex:
Thin and wispy, the cortex is like a layer of tape stuck to the inner aspect of the capsule. Using aspiration and vacuum power, it is peeled off at the end of the case. It requires no emulsification.

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