Introduction to Contact Lenses

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History of Contact Lenses

- 1508 – Leonardo DaVinci - sketches of lens-enclosed liquid reservoir to optically neutralize the cornea
- 1636 - Rene Decartes – creased a telescope to correct myopic blur and improve vision
- 1887 – F. A. Muller – created the first scleral contact lens for patient with recurrent corneal ulcer
- 1888 - Adolf Eugene Fick – reports using scleral contact lens to correct ammetropia
- 1888 – E. Kalt (French Optician) – reports fitting scleral contact lens to correct Keratoconus
- 1889 – August Muller – Publishes doctoral thesis on correcting high myopia using scleral contact lenses
- 1946 – Kevin Tuohy – Develops corneal PMMA lens (files patent in 1948)

PMMA lens ultimately replaced by Rigid Gas Permeable lens because of its impermeability to Oxygen
History of Contact Lenses

- 1963 Otto Wichterle and Dr. Drahoslav masde first soft contact lens called HEMA (hydroxyethyl methacrylate)
- 1968 FDA classifies all contact lenses as Drugs
- 1971 first FDA approved daily wear contact lens
- 1978 - The Medical Devices Act of 1976 reclassifies hydrogel contact lenses as medical devices
- 1987 Disposable lenses were introduced to United states
- 1999 modern Silicone Hydrogel Lenses entered market
- 2001 FDA expanded this approval to a maximum of 30 day wear, based on safety evidence outside of the US
Lens Power

- Contact lenses, although physically thin, are optically thick
- The disparity between Back Vertex Power and Front Vertex Power increases with thickness, therefore it becomes more significant in Plus than in Minus
- Clinically significant at $\geq +10.00$ D (aphakic patients)

\[
F (BVP) = \frac{F1}{1 - \left(\frac{t}{n}\right)F1} + F2
\]

\[
F (FVP) = \frac{F2}{1 - \left(\frac{t}{n}\right)F2} + F1
\]
Surface Power

- Surface power of the cornea is measured indirectly by measuring the corneal radius and converting to diopters based on an index of refraction of 1.3375
  - \( F = \frac{n' - n}{r} \)
  - \( n' = 1.3375 \)
  - \( n = 1 \) (air)

- Keratometry
Contact Lens Terminology

- **Flexture**
  - rigid lenses generally do not conform to the shape of the cornea; hydrogel lenses generally do
  - contact lens flexure is a term used to describe conformity

- **Effectivity**
  - the position of the correction lens (or “vertex distance”) affects the power required to optimally correct for the patient’s refractive error at distance
  - this becomes clinically significant at 4.00D
  - each meridian should be calculated separately
  - \[ F' = \frac{F}{1-dF} \]
Accommodation

- The position of the correcting lens also affects the power required to optimally correct for the patient’s refractive error at near, although not by the same magnitude.
- Accommodation with a contact lens approximates that of an emmetrope.
- This becomes clinically significant at >3.00D.
- Therefore the following relationship exists:
  - Accommodative demand is GREATER for a contact lens wearing MYOPE than for a spectacle wearing myope.
  - Accommodative demand is LESS for a contact lens wearing HYPEROPE than for a spectacle wearing hyperope.
- Clinically significant for early presbyopes.
Prism and Contact Lenses

- **Prismatic Effects**
  - Contact lenses minimize the prismatic effects encountered when the eye is not looking through the optical center of the lens
  - Usually this is desirable – occasionally it is not

- **Prism in Contact Lenses**
  - Prisms are used in contact lenses for stabilization purposes and rarely to correct for vertical (up to 2.5pd theoretically of imbalance)
  - \( P = h(BVP) \)
    - \( P \) = prismatic power in prism diopters
    - \( H \) = distance from optical center in cm
    - \( BVP \) = back vertex power
Spectacle Magnification

- Spectacle magnification is the ratio of the image size of the corrected ametrope to the retinal image of the same eye uncorrected.

- For spectacle wearing myope, the image size is reduced; for spectacle-wearing hyperope, the image size is enlarged when compared to the uncorrected eye.

- Contact lens wearing myopes often report that the image is clearer because the retinal image is larger.

- Relative spectacle magnification, however, refers to the comparison of the retinal image to an emmetropic eye.

- In this case, axial refractive errors result in the same magnification as the emmetropic eye when corrected with spectacles.

- This theory suggests that axial refractive error should NOT be corrected with contact lenses (Knapp’s Law).
Knapp’s Law
Physical Properties of Materials

- **Oxygen Permeability** (Dk) – In this nomenclature,
  - D is the diffusion coefficient – a measure of how fast dissolved molecules of oxygen move within the material – and
  - k is a constant representing the solubility coefficient or the number of oxygen molecules dissolved in the material.
- This is a physical property.
- It is defined as *the rate of oxygen flow under specified conditions through unit area of contact lens material of unit thickness when subjected with unit pressure differences*
- **How much O₂ the lens allows to go through**
- High Dk materials do not always give the oxygen performance on the eye that would be expected from a laboratory result. Corneal swelling is equivalent to that of a lens with a Dk only 55% of the measured value.
Physical Properties of Materials

- **Oxygen Transmissibility** (Dk/t) – where
  - \( t \) is thickness of the lens or sample material.
  - This is not a physical property, but a specific characteristic related to the sample thickness.
  - *For a particular lens under specified conditions defines the ability of the lens to allow oxygen to move from the anterior of the lens to the posterior of the lens.*

- **Calculates Thickness with Dk**

- Thickness varies with power and location on the lens
Physical Properties of Materials

- **Wettability** is the ability of a drop of liquid to adhere to a solid surface.
  - The lower the cohesive forces within a liquid, the greater the attraction between the fluid and surface.
  - Thus, superior wettability enhances the spread of liquid over a surface.
  - The Contact angle is the measure of the hydrophilicity of a surface. The lower the contact angle, the more wettable the surface.
- Provides patient comfort and uniform distribution of water over contact lens surface
Contact Lens Types

1. Rigid Gas Permeable lenses (RGP)
2. Polymethyl methacrylate (PMMA)
3. Soft Lenses
   1. Silicone Hydrogels
   2. Biocompatible lenses
   3. Silicone Lenses
Patient Motivation for Contact Lens Wear

1. Cosmesis

2. Convenience
   1. Ex. Monovision in presbyopes
   2. Ex. No glasses sliding down face

3. Improved vision
   1. Myopia – increased retinal image size
   2. Hyperopia and Amblyopia – decreased aberrations and prismatic effects

4. Sports

5. Hobbies

6. Occupation
Relative Contraindications

1. Allergies
2. Dry Eye
3. Compromised Cornea (exception: Bandage Contact Lens)
4. Medications (that create dry eye)
   1. Antihistamines, diuretics, tri-cyclic antidepressants, oral contraceptives
5. Systemic conditions (that cause healing issues)
   1. Diabetes, thyroid, Lupus, Rheumatoid Arthritis, pregnancy
6. Monocular patients
   1. Amblyopia or Trauma – they have only “1 good eye” if something goes wrong
7. Environment
   1. Dust (rigid lenses),
   2. Chemicals (soft lenses soak up fumes)
Refractive Information

1. Corneal Shape
   1. Keratometry
   2. Autokeratometry
   3. Photokeratoscope
   4. Placido Disc
   5. Topography – Axial and Tangential

2. Spectacle refraction
   1. Consider vertex distance of ≥4.00

3. Calculated residual astigmatism
Hydrogel Lens Design and Fitting

• Initial Base Curve Selection
  1. 0.40-0.60mm FTK for smaller OAD (12-13mm) or 0.60mm FTK for larger OAD (14-15mm)
    1. Flatter for larger diameter lenses because of sagittal depth
    2. Ex. K: 42.65/45.00@70
      1. (Assume 14mm OAD) Convert flat K to mm (7.89 mm), add 0.60mm – 8.49
    2. 4D FTK
      1. 4D Flatter than K = 38.75
      2. Convert to mm of radius with the following equation 0.3375/38.75 = 8.71
  3. Average K Readings = 41.00-45.00
    1. Fit with middle BCR → most hydrogel lenses are available in 1 to 4 BCR
    2. Ex, average K readings use middle BCR; if available in 8, 4, 8.7, 9.0 use 8.7mm
  4. Manufacturer guidelines
  5. Clinical Experience
Hydrogel Lens Design and Fitting

- **Diameter (Horizontal- visible Iris Diameter)**
  - 1 mm larger than HVID
  - 0.5-2.00mm acceptable

- **Power**
  - Spherical equivalent
    - 2.00-0.50x180, initial lens -2.25D
  - Vertex Distance
    - -4.00DS spectacle Rx; initial ilens -3.75D
  - Over-refraction (Orx)
    - Trial lens = -2.75D, over refraction = -0.50D, final lens power = -3.75
    - Trial lens = -3.00D, over refraction = -4.00D, final lens power = (-3.00-3.75) = -6.75
Evaluation of Soft Contact Lenses

- **Coverage**
  - 0.50mm coverage 360° minimum
  - Recording “complete” vs “incomplete”

- **Centration**
  - Avoid flare or distortion
  - Recording:
    - “good centration” or “slightly temporal decentration but adequate”
    - “poor centration” or “excessively inferior decentration”
Evaluation of Soft Contact Lenses

- **Movement**
  - 0.50-1.00mm in primary gaze
    - Usually more in superior gaze
  - Material and thickness dependent
    - A thin lens may move less
    - Expectations vary with material
    - A wrinkle or bubble in the lens means a **tight** fitting lens
    - If a lens falls, then the lens is too loose

- **Recording**
  - “adequate”, “inadequate”, “Excessive”,
  - May be described qualitatively or quantitatively

- **Push up test**
  - Used to assess movement of lens when movement is marginal
  - Technique: Push on the lower lid
    - If CLs resist, then (-) push up test
    - If CLs moves easily, the (+) push up test
<table>
<thead>
<tr>
<th>Brand CL</th>
<th>Manufacturer</th>
<th>Material/H2Ocontent</th>
<th>dK Value</th>
<th>Replacement Schedule</th>
<th>Base Curve</th>
<th>Diameter</th>
<th>Price (6 month supply)/ eye</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acuvue Oasys*</td>
<td>Johnson &amp; Johnson (Vistakon)</td>
<td>SiHy with UV Blocker, 38%</td>
<td>103</td>
<td>2 weeks DW (1 week EW)</td>
<td>8.4,8.8</td>
<td>14.0</td>
<td>$80 ($320/yr)</td>
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<tr>
<td>Acuvue 2</td>
<td>J&amp;J</td>
<td>Hydrogel, 58%</td>
<td>28.0</td>
<td>2 week DW</td>
<td>8.3,8.7</td>
<td>14.0</td>
<td>$60 ($240/yr)</td>
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<tr>
<td>Biofinity</td>
<td>Coopervision</td>
<td>SiHy, 48%</td>
<td>128</td>
<td>Monthly (DW/EW)</td>
<td>8.6</td>
<td>14.0</td>
<td>$55 ($220/yr)</td>
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<tr>
<td>Proclear</td>
<td>Coopervision</td>
<td>Hydrogel, 62%</td>
<td>27.0</td>
<td>Monthly DW</td>
<td>8.2,8.6</td>
<td></td>
<td>$50 ($200/yr)</td>
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<tr>
<td>Air Optix</td>
<td>Alcon</td>
<td>SiHy, 33%</td>
<td>110</td>
<td>Monthly (DW/EW)</td>
<td>8.6</td>
<td>14.2</td>
<td>$55</td>
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<td>Air Optix Night &amp; Day*</td>
<td>Alcon</td>
<td>SiHy, 24%</td>
<td>140</td>
<td>Monthly EW (FDA approved to stay in for 30 days and nights)</td>
<td>8.4, 8.6</td>
<td>13.8</td>
<td>$100 ($400/yr)</td>
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<td>Purevision*</td>
<td>Bausch and Lomb (B&amp;L)</td>
<td>SiHy, 36%</td>
<td>91</td>
<td>Monthly</td>
<td>8.3,8.6</td>
<td>14.0</td>
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<td>Ultra</td>
<td>B&amp;L</td>
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<td>8.5</td>
<td>14.2</td>
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<td>Biomedics 55</td>
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<td>Hydrogel, 55%</td>
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<td>2 Weeks DW</td>
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<td>14.0</td>
<td>$35</td>
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<td>Fresh Look Color</td>
<td>Alcon</td>
<td>Hydrogel, 55%</td>
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<td>14.5</td>
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<tr>
<td>Brand CL</td>
<td>Manufacturer</td>
<td>Material/ H2O content</td>
<td>dK Value</td>
<td>Replacement Schedule</td>
<td>Base Curve</td>
<td>Diameter</td>
<td>Price (90 pack)/ eye</td>
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<tr>
<td>-------------------</td>
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<tr>
<td>Dailies Total 1</td>
<td>Alcon</td>
<td>SiHy 33%</td>
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<td>14.1</td>
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<td>Alcon</td>
<td>Hydrogel, 69%</td>
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<td>Daily</td>
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<td>Soflens Dailies</td>
<td>Bausch &amp; Lomb</td>
<td>Hydrogel, 59%</td>
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<td>Daily</td>
<td>8.6</td>
<td>14.2</td>
<td>$90</td>
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<tr>
<td>Proclear 1 Day</td>
<td>CooperVision</td>
<td>Hydrogel, 60%</td>
<td>25.0</td>
<td>Daily</td>
<td>8.7</td>
<td>14.2</td>
<td>$90</td>
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<tr>
<td>MyDay</td>
<td>CooperVision</td>
<td>SiHy, 54%</td>
<td>80</td>
<td>Daily</td>
<td>8.4</td>
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<td>Clariti 1 Day</td>
<td>CooperVision</td>
<td>SiHy, 56%</td>
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<td>Daily</td>
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<td>14.1</td>
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<td>Acuvue 1 Day Moist</td>
<td>J&amp;J</td>
<td>Hydrogel, 58%</td>
<td>28.0</td>
<td>Daily</td>
<td>8.5, 9.0</td>
<td>14.2</td>
<td>$90</td>
</tr>
<tr>
<td>Acuvue Oasys 1 Day</td>
<td>J&amp;J</td>
<td>SiHy, 38%</td>
<td>103</td>
<td>Daily</td>
<td>8.5, 9.0</td>
<td>14.3</td>
<td>$115 ($920/yr)</td>
</tr>
</tbody>
</table>
Problem Solving

• Fitting Relationship Relating to Sag Depth
  • Base curve is the same for D2 and D3 but D2 has larger sag depth
  • If the lens diameter ↑, then sag depth ↑ = a tighter lens
  • If the lens diameter ↓, then sag depth ↓ = a looser lens

• Fitting Relationship Relating to BCR
  • Steeper BC = tighter fit (smaller in mm, larger in Diameter)
  • Flatter BC = looser fit (larger in mm, smaller in diameter)
Steeper than $K$ (apical clearance)

On $K$ (apical alignment)

Flatter than $K$ (apical bearing)
Dispensing and Follow up

- Recommended Testing (assuming dispensing and fitting is not the same)
  - Entering Vas with pinhole
  - Biomicroscopy
  - Lens insertion
  - Visual acuity
  - Over refraction (spherical if ≥ 20/20)
  - Lens fit evaluation
    - Coverage
    - Centration
    - Movement
Dispensing and Follow Up

- Patient information
  1. Informed consent
     - Disclosing all abnormalities
     - Risk of proposed treatment plan
     - Alternative treatment options
  2. Hygiene & cosmetic use prior to lens handing
  3. Lens case care (rinse, air dry, replace monthly)
  4. Wearing schedule ("4+2")
  5. Lens care instructions
  6. Lens insertion, removal, recentering
  7. Spectacle as a backup
  8. Recall
  9. After hours contact
Lens Care Components (CRADLE = Care, Rinse, And Disinfect Lenses Everyday)

- Daily Cleaner – removes loosely bound foreign matter, usually with a surfactant
- Rinse- removes daily cleaner, loosened deposits, microorganisms or to rinse after overnight storage

1. Saline
   - Formerly preserved with Thimersol (mercury based) which is often toxic to the cornea → preservatives today are less toxic to varying degrees (sorbic acid, potassium sorbate, polyquad, and biguanide (dymed))
   - Unpreserved formerly made with distilled water & NaCl tablets (“home-made”) → discontinued because its use was associated with serious ocular infection (Acanthamoeba Keratitis)
   - Unpreserved saline is available today via 1) unit dose vials, 2) aerosol containers 3) special buffering system with anti-microbial activity

2. Multipurpose Solution with common preservatives
   - Timersol, sorbic acid, benzyl alcohol, polyaminopropyl biguanide (PAPB)/Dymed, Polyquad, Aldox, polyhexanide
Lens Care Components

- Disinfectants – kill or deactivates potentially pathogenic organisms

1. Chemical
   - Preservatives may be toxic to the eye
   - May be used on all lens types & has little effect on life of the lens
   - Surfactant cleaning is an important precursor to disinfection
   - Chemical disinfection has a negligible effect on acanthamoeba
   - Most prevalent today

2. Oxidative
   - Proven efficacy (well documented)
   - Eliminates preservative sensitivities
   - Some patients may experience irritation from residual peroxide
   - CDC condoned as effective against AIDS/HIV virus

3. Thermal (Heat)
   - **Disinfection** -- 80°C for 10 min – **does NOT kill spores**
   - **Sterilization** -- 121°C for 15 min at 15 psi when the lens is manufactured – **Kills spores**
Rewetting drops

- Utilized with symptomatic patient
- Recommend with extended wear
- Do not substitute with cleaning lenses
- Functions
  - Rehydrates lens
  - Alleviates discomfort
  - Flushes debris from the lens & eye
- Lens Storage case – replace periodically (CDC recommends every 3 months)
Cleaning lenses for Part time wearers

- Clean and disinfect at least every 30 days (recommended by manufacturers) – realistically should be every week

- Clean and disinfect within 24 hours of reapplication

- Identify which lens care system are better for long-term storage
Clinical pearls of Lens care system

- Conventional wear – consider periodic cleaners and/or oxidative
- Planned replacement/2 weeks or more frequent – multi-purpose solution
- Patients with allergies – oxidative (hydrogen peroxide); use with preservative free saline
- Patients with protein deposits – periodic cleaner or more frequent replacement
- Patients with lipid deposits – alcohol based cleaner or more frequent replacement
Astigmatic Compensation

- A pneumonic device for compensation of axis for astigmatic contact lens correction is “LARS”
- It is measured from the vantage point of the practitioner viewing the patient and always related to the SPECTACLE prescription (vision correction) rather than the trial lens
- LARS = Left Add Right Subtract
- Remember 1 clock hour = 30°
Lens Stabilizing Techniques (soft toric CL)

1. Prism Ballasting
   - Thick part on bottom, more common stabilizing technique
   - “watermelon seed effect” – upper lid squeezes of the lens
     - Adv: better with oblique axis
     - Disadv: lens thicker inferior, reduces O2 transmission

2. Truncation
   - Less truncation (1mm) for smaller diameter lenses
   - Larger truncation (1.5mm) for larger diameter lenses
   - Tends to loosen the fit of the SCL
Lens Stabilizing Techniques (soft toric CL)

3. Dynamic Stabilization (“double thin zones”)
   - thick center, thin on the edges by lids & lids keep it in place
   - Adv: lens remains thin overall, good edge comfort with thin edges
   - Disadv: careful SLE to assess orientation

4. Periballasting – like prism ballasting but not prism on visual axis

5. Back toricity vs Front Toricity
   - Use back surface toric SCL for toric cornea patient
   - Use front surface toric SCL for lenticular astigmatism Pt

6. Larger overall diameter
   - Good stabilizing technique when used with 1 of the other techniques
Board Question

- You are fitting a patient with a soft toric contact lens. His refraction in the right eye is -2.50-1.25x090. You happen to have this exact contact lens and place it on the patient. You note that the mark indicating the 6 o’clock position is in the 4 o’clock position. Which of the following contact lens prescriptions should you order for this patient?

A. -2.50-1.25x90
B. -2.50-0.75x90
C. -2.50-1.25x30
D. -2.50-0.75x60
Toric soft contact lenses often have a centering mark in the approximately 6 o'clock position. A general rule of thumb is that if the mark has shifted to the Left then you Add the corresponding amount of cylinder axis. If the mark has shifted to the Right then you Subtract the corresponding amount of cylinder axis. This can be remembered with the mnemonic LARS.

One clock hour is equivalent to 30 degrees. In this patient, the mark has shifted to the right 2 clock hours, which is equivalent to $2 \times 30 = 60$ degrees. Therefore, you will order the contact lens in the $90 - 60 = 30$ degree axis.
A patient with a manifest refraction of -2.00-1.00x030 is fitted with a toric soft contact lens with astigmatic axis of 30 degrees. On slit lamp exam of the right eye, the contact lens is well-centered but the 6 o’clock marking is actually located at the 8 o’clock position. What axis of the contact lens should be ordered for this eye?

A. 30 degrees  
B. 60 degrees  
C. 90 degrees  
D. 150 degrees
The fit of a soft toric contact lens is similar to fitting other soft lenses, except that lens rotation must also be assessed. Most toric contact lenses have a etched mark to note the 6 o'clock position. If the lens fits properly on the eye, this mark should rest on the eye's 6 o'clock position. If that mark is not at the 6 o'clock position, then the same-brand lens with a different astigmatic axis should be dispensed.

The mnemonic that is used in this situation is: LARS (Left Add; Right Subtract). In the above vignette, the mark is resting at the eye's 8 o'clock position which is to the "Left" of the 6 o'clock position. Thus, you must "Add" to the axis. The only other value you need to remember is that 1 clock-hour equals 30 degrees. Thus, for this example, 30 * 2 = 60 degrees must be "Added" to the contact lens axis; or: 30 + 60 = 90 degrees.
Devices for Contact Lens Verification

- Power (F) with the Lensometer
- Overall Diameter (OAD) – measured with Loupe
- Base Curve Radius (BCR) and Center Thickness (CT) with the Radiuscope
  - RGP only
- Water content (%) with the Refractometer
Fitting RGP

- Information required
  1. Accurate refraction
  2. Accurate keratometry readings
  3. Horizontal Visible Iris Diameter
  4. Vertical Palpebral aperture
  5. Pupil size in average and low illumination
RGP Lens Selection

- Starting Point for Lens Diameter
  - OAD = 9.2mm
    - Average starting value
  - OZD = 7.80mm
  - Diameter = HVID – 2.3mm (alternative)
**Bennett Base Curve Radius**

<table>
<thead>
<tr>
<th>Corneal Cylinder</th>
<th>Initial Base Curve Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.50D</td>
<td>0.50-0.75 FTK</td>
</tr>
<tr>
<td>0.75-1.25D</td>
<td>0.25-0.50 FTK</td>
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<tr>
<td>1.50D</td>
<td>On K</td>
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<td>1.75-2.00D</td>
<td>0.25 STK</td>
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<tr>
<td>2.25-2.75D</td>
<td>0.50 STK</td>
</tr>
<tr>
<td>3.00-3.50D</td>
<td>0.75 STK</td>
</tr>
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</table>

Ex. If K’s are 43.00/43.00 → 0.50 Flatter = 42.50D
Ex. If K’s are 40.00/42.50 → 2.5 D corneal cyl → 40 + 0.50STK = 40.5
Fitting Philosophy

1. Lid Attachment (Korb)
   - Peripheral lens contour
   - Edge contour
   - Edge thickness (0.08, 0.20 from apex)
   - Lens mass decreased (TAP)
   - BCR (FTK)

2. Interpalpebral
   - Early fitting philosophy
   - Lens to corneal alignment
   - Fits between superior and inferior lids
   - Utilized if lid tangent to or above superior limbus
   - Not as comfortable

3. Modified Lid Attachment
   - Something in between
Rigid Lens Evaluation

- Pooling appears green, bearing appears dark
- Dumbbell pattern if corneal cylinder > 1D in flat meridian
- Areas of evaluation

<table>
<thead>
<tr>
<th><strong>Apical Clearance (pooling)</strong> – lens if fit steeper than the cornea</th>
<th><img src="image1" alt="Image" /></th>
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<tbody>
<tr>
<td><strong>Apical Touch (Bearing)</strong> – lens if fit flatter than the cornea</td>
<td><img src="image2" alt="Image" /></td>
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Rigid Lens Evaluation

<table>
<thead>
<tr>
<th>Alignment</th>
<th>“Minimal Apical Clearance” (MAC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dumbbell has bearing in flat meridian</td>
<td>example shows WTR fitted on K</td>
</tr>
</tbody>
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Flat Lens

- Touching or bearing in the middle surrounded by clearance
- Darkness indicates pressure on the cornea
- Smaller darker areas mean even greater degrees of flatness (the smaller the area, the flatter the fit)
- Large amounts of movement and decentration
- Blinking causes a lot of movement, and the lens is dropped inferiorly if too flat
- For lenses that do not lid attach, the lens is pulled up on a blink, and then dropped back down into position
Steep Lens

- Central area of clearance
- Much more comfortable because they fit tighter to the cornea
- Lack of lens movement
- Good initial comfort but complaints of blurry vision or redness and irritation by the end of the day
- Centers well
Steps to correcting for Lens Types

- **Flat lens**
  - Increase the diameter first by 0.4mm
  - Steepen the base curve by 0.1mm
  - Don’t forget to change the power! Flatten – Add PLUS!

- **Steep Lens**
  - Decrease the diameter first by 0.4mm
  - Flatten the base curve by 0.1mm
  - Don’t forget to change the power! Steepen – Add MINUS!

- For every half step chance in BC, change power by a quarter
Board Question

If a patient’s refraction (assuming 13mm vertex) is: +11.50+1.00 x 035; the keratometry readings are 44.25/45.87, and the base curve chosen is 44.75, what is the power of the final rigid gas permeable (RGP) lens?

A. +12.00
B. +13.50
C. +14.00
D. +14.50
This problem may be considered as a rite of passage for standardized board exams. Start by converting the refraction into minus cylinder form:

\[ +11.50 +1.00 \times 035 \quad == \quad +12.50 -1.00 \times 125 \]

Then we can get rid of the cylinder and axis, leaving us with the +12.50 D. But we now have to convert this to zero vertex distance (see the diagram below):

\[ \text{far point} = \frac{1}{12.50} \]

\[ \text{far point} = 0.08 \text{ m} = 80 \text{ mm posterior to the original lens} \quad \text{OR} \]
\[ \text{far point} = (80 - 13) \text{ m} \text{ posterior to the corneal surface} \]

The power of the correcting RGP at the corneal surface is thus:

\[ \text{power of RGP on corneal surface} = \frac{1}{(0.080 - 0.013)} = \frac{1}{0.067} = +15.00 \text{ diopters} \]

After obtaining the power corrected for vertex distance, we still have to deal with the tear lens.

The problem states that we fitted +0.50 steeper than the flattest K (i.e. 44.25), so we have created a PLUS tear lens. Using the "SAM-FAP" rule, we therefore must ADD MINUS (-0.50) to the final refraction (i.e. +15.00).

Therefore: \[ +15.00 - 0.50 = +14.50 \text{ D} \] (Choice D).

* "SAM-FAP" mnemonic is: if steep add minus; if flat add plus"
A patient wears +5.00D Contact lenses. He now gets +5.00 spectacles and wears them with a vertex distance of 20mm. What is the change in magnification in using these spectacles?

A. 0.90  
B. 1.00  
C. 1.11  
D. 1.24
This is a question regarding lens effectivity. Specifically, this question tests whether you know how the power of a lens will change as you move the lens further from the eye. The basic premise is this:

Moving a lens (either plus or minus) away from the eye gives it more effective plus power

To calculate the new effective power of this plus lens, you need to calculate the new focal length:

new focal length = old focal length - distance moved from eye

new focal length = 0.2 m - 0.020 m = 0.180 m
Board Question

- What is the name of the device that measures the base curve of a contact lens?

  A. Keratoscope
  B. Radiuscope
  C. Retinoscope
  D. Basometer
• A Radiuscope is a device that measures base curve of a contact lens
• A keratoscope measures corneal curvature
• A retinoscope is used in refraction
• There is no such thing as a basometer