

BASIC GUIDELINES OF RIGID GAS PERMEABLE CONTACT LENS FITTING

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Three main areas should be considered:

1. Initial data gathering
2. Lens Fit Analysis
3. Ordering of the rigid gas permeable (RGP) lens.

1. Initial data gathering:

- Recent routine refraction - note the visual acuity and back vertex distance.
- Full eye examination including a slit-lamp assessment.
- Visual fields test, tonometry and binocular control tests.
- Keratometry and/or Keratotomy.

All these should have been performed in the preliminary examination.

Measurements are required of the horizontal visible iris diameter (HVID), the vertical palpebral aperture, and the pupil diameter in various illumination conditions.

- The HVID gives an initial clue as to the overall lens diameter, usually approximately 2 mm less than HVID.
- A narrow palpebral aperture indicates the use of a small lens diameter, e.g. 8.50-9.00mm;
- A patient with a wide palpebral aperture is more likely to need a larger lens diameter, e.g. 10.00-10.50mm. This helps the upper lid grasp the lens edge to prevent the lens riding low.

The position of the lids is important.

- If the upper lid is positioned high or beyond the superior limbus, either the lens could be lifted too high by tight lid tension or ride too low because the lid is too loose or rarely reaches down on blinks to lift the lens to a central position.
- For the lower lid, if this covers the inferior limbus then the lid margin is likely to support the lens and aid lens centration. However, if the lower lid is in a low position, the support given is minimal so the lens may ride low.

Tear film assessment using the slit lamp.

- Part of the ocular examination is the assessment of tears quantity and quality. Tears quantity at the lid margin can be estimated by observing the tear prism, which is normally 0.2-0.4mm at the centre. The Schirmer test could give a further measure of tears volume.
- Tears quality can be assessed by noting the tear break-up time after the instillation of a drop of fluorescein, a few blinks to spread the yellow dye in the tears, followed by the patient staring ahead. A typical break-up time is 15 seconds.
- Non-invasive break-up time methods avoid the use of stains, but involve either a projected pattern or a special cold diffuse light source shone onto the cornea, e.g. Tearscope.
- Specular reflection is used with the slit lamp to search for debris moving in the tears film and to study the first Purkinje image of the lamp to show possible coloured fringes. These moving swirls of colour give a relative estimate of the tear film thickness. They can also indicate lipid layer movement and disturbances.

A suitable RGP lens is selected based on the available information and inserted into one eye. An assessment and note of the lens fit and performance is made. Suitable modifications may be suggested to improve the fit and these may be discussed. The practitioner must specify an order for the required RGP contact lens to be manufactured.

2. Lens fit analysis

- The first choice lens usually has a back optic zone radius of curvature (BOZR) nearest to the flattest keratometry 'K' reading. When the corneal astigmatism is approximately 1.50D, for the fitting of a traditional tri-curve (C3) design, a lens BOZR of 0.05-0.10mm steeper than the flattest keratometry reading would be chosen.
- An aspheric lens design is more likely to closely follow the mid-peripheral corneal contours, to spread the lens pressure on the cornea more evenly and to improve comfort. For this design a lens BOZR on flattest 'K' reading is preferable. This lens can reduce lens flexure on blinks and can help to obtain good visual acuity and tear flow with a spherical lens centre. An aspherical design lens can often mask corneal astigmatism better than can a tri-curve lens, so avoiding the need to fit a toric lens design.

*Example: 'K' = 8.00mm along 180/ 7.90mm along 90,
Tri-curve and aspheric design BOZR = 8.00mm'*

*Example: 'K' = 8.00mm along 180 /7.70mm along 90,
Tri-curve lens BOZR = 7.90mm. Aspheric design BOZR = 8.00mm.*

- Keratometry only measures the central corneal curvature, yet the RGP lens also rests on the corneal periphery. Three patients, all with 'K' reading of 7.80mm spherical and with identical RGP lenses of 7.80mm BOZR may show differing fluorescein fit patterns.
- One has a good alignment fit on their normal corneal contour.
- A second has peripheral corneal contours that flatten to a much lesser degree than normal. There will be a greater amount of lens edge clearance and the lens fit will be loose.
- A third has peripheral corneal contours that flatten much more than normal. The lens will appear a tight fit with the edge pressing the cornea and inhibiting tears flow beneath the lens. The practitioner should progress to a contact lens of a greater BOZR (e.g. 7.90 mm) or a more suitable flatter edge design.

The choice of lens BOZR also depends on the back optic zone diameter (BOZD).

- For example, on an eye with a corneal curvature of 7.60mm over a chord of 5.50mm, a lens of BOZR of 7.85mm over a chord of 5.6mm may touch on the cornea centrally but is liable to rock in movement and to exhibit lens edge stand-off.
- If a 7.70mm BOZR lens over a chord of 6.0mm is tried, this will touch the mid-peripheral cornea just beyond the central region and give a central tears clearance of about 0.1mm. This may prove to be a satisfactory lens fit.
- A guide is that where a large lens BOZD is required e.g. 8.00mm, to cope with a large pupil, a flatter BOZR of flattest 'K' plus 0.1mm is selected to obtain an alignment fit.

Effect of Lens Thickness

- If a lens has a back vertex power (BVP) of greater than +4.00D, the lens front surface shape and thickness may affect the fitting. Relatively, the thick positive power lens is heavy and its centre of gravity is in front of the corneal apex, therefore the lens is liable to ride in a low position. A steeper fit would often be needed, either using a smaller BOZR or a greater BOZD, to increase the sagittal height of the central lens portion over the cornea. As the lens edge is much thinner than the centre, the lid may 'lose grip' of the lens edge after a blink, thereby allowing the lens to ride to a low position.
- If the lens power is a minus power, the centre of gravity is posterior to the corneal apex and the lids can grasp the relatively thicker lens edge to lift the lens to a central position. Sometimes tense upper lids may grasp the lens edge too tightly and lift the lens too high. This often results in superior region limbal discomfort and in poor coverage of the pupil. A thinner smoother lens edge may reduce this problem.

Lens Diameter

- The choice of BOZD is often pre-determined by that usually given in a particular lens design, as described in the ACLM catalogue of lens parameters. A small BOZD is about 7.20mm or less, medium is 7.20-7.90mm, large is about 8.00mm or greater. High power lenses tend to be made in a lenticular design to minimise thickness. They are likely to have a reduced BOZD (e.g. 7.00mm) in order to be less than the front optic zone diameter (FOZD) and to decrease light flare at the edge of the optic power region.
- In cases where the pupil is large, a design with a larger BOZD is required, e.g. at least 1.0-2.0 mm larger than the maximum pupil size, to ensure pupil coverage when the lens moves. One should remember that a larger BOZD results in a greater tears pool beneath the lens and a steeper lens fit, so the BOZR may need to be flattened in order to retain an equivalent alignment lens fit. When ordering a lens with a very large BOZD, to avoid having a narrow peripheral lens portion with a sharper transition, a lens with a larger overall diameter with rapidly flattening peripheral curves may be necessary.
- A large overall lens diameter may be preferred in order to help pupil coverage, to assist lens centration particularly if the palpebral aperture is wide, and in some cases to stabilise the lens fit if there is excessive lens movement. A small lens diameter is about 9.10mm or less, medium is 9.10 -9.80mm and large is greater than 9.80mm. If the pupil dilates to 8.00mm, the lens overall diameter should be at least 10.00mm to provide adequate pupil coverage.

Lens Fit

The lens fit is assessed after a drop of fluorescein is instilled, the patient blinks several times and the fluorescein pattern observed using the Burton lamp for a general view with the patient's head in a natural position. The slitlamp with the cobalt blue filter can be used for a more detailed view of the lens fit pattern and tears flow. The lens centration, movement and fit should be noted, during the primary position of gaze and on eye version movements.

A good fit shows:

- Satisfactory lens centration.
- With lids held apart, the lens should slowly drop downwards.
- With normal lid position, the lens periphery should not move beyond the limbus.
- Alignment type fluorescein pattern shows alignment or slight apical clearance over the central 7.00mm region, mid-peripheral touch and edge clearance of about 0.50mm width.

A flat fit shows:

- A central blue area of apical touch and absence of fluorescein. This should not be confused with a very tight lens where there is no green glow because the fluorescein cannot get under the lens. A flat fit usually shows a broad green edge band of lens clearance.
- Patients may lacrimate profusely during fitting so the lens may be a correct fit yet the lens gives the impression of a loose, mobile fit where much of the fluorescein has washed away.
- To improve a flat fitting, choose a steeper curve lens with smaller BOZR, or a larger BOZD for a deeper central tear depth. One could re-fit with a larger overall lens diameter to encourage the lids to help with lens position stability, or consider a smoother or thinner lens design to allow the lids to glide easily over the lens rather than push the lens down.

A steep fit shows:

- The appearance of central green tears pooling beneath the lens, sometimes with trapped bubbles under the lens, blue heavy touch of the lens at the mid-peripheral transition region, and minimal lens edge clearance. The movement is rather static and sluggish even when the lens is pushed. There may be corneal epithelial indentation by the lens edge.
- To improve a steep fit lens try a flatter (larger) BOZR, a smaller BOZD, flatter peripheral curves or a smaller overall lens diameter.
- As a general guide, an increase of 0.05mm in BOZR requires an increase of 0.50mm in BOZD to give the equivalent fluorescein pattern.

3. Lens ordering

The ocular refraction (Oc.Rx) at the corneal plane can be calculated from the spectacle prescription and the back vertex distance (BVD). This suggests the contact lens power to expect if an alignment lens is achieved. Approximately 0.25D change occurs for each 4.00 dioptres of power.

E.g. at BVD = 14mm,
+ 4.00D spectacles result in Oc.Rx = + 4.25D
- 4.00D spectacles result in Oc.Rx = - 3.75D

The optical effect of the tears should be considered.

- For example, on an eye of 'K' reading = 7.70mm sphere, a 7.70mm BOZR RGP lens is tried but appears loose due to poor lid support. A lens of 7.60mm BOZR is tried and achieves a good fit. The positive power tear pool beneath this lens must be taken into account when calculating what lens power to order and judging whether this is the power expected from ocular refraction.
- A rough guide is that a RGP lens of BOZR fitted 0.1mm steeper than flattest 'K' reading will lead to a +0.50D power tear pool. Therefore an extra -0.50D must be incorporated in the ordered lens power to neutralise this effect.

The ordered lens specification must be clearly written. For example:

A lens of BOZR 7.70, BOZD 7.00mm, and overall diameter 9.20mm gives a good fit, the lens specification may be written as follows:

For a small palpebral aperture

*BOZR: BOZD/2nd radius: 2nd diameter/Peripheral radius: Overall diameter.
7.70:7.00/8.90:7.80/10.80:8.60 (-2.00) Boston IV Blue tint, well blended, marked 'R'.*

For a large palpebral aperture

7.70:7.80/8.10:8.80/8.90:9.80 (-2.00) FL70, grey tint, blended, marked dot.

The RGP lens material choice can depend on certain characteristics of the patient. If the tears are relatively greasy or have mucus debris, good wettability and deposit resistance of the material is most important. The practitioner should avoid choosing lens materials that tend to attract lipids that would render the lens surface hydrophobic.

Corneas vary in their demands for oxygen so some lenses need to be of high oxygen transmissibility. Some patients prefer a lens of lower oxygen transmissibility but of more rigid, scratch resistant material. Their methods of lens handling and cleaning tend to damage the lens, despite further instruction lessons. A flatter fitting lens that encourages more oxygen supply to the cornea via the tears would be useful in this case.

The practitioner is reminded that successful RGP lens fitting is not just obtaining a contact lens of correct curvature and power, but includes educating the patient in the appropriate wear and care of the lens and continuing to monitor the eye at the regular aftercare visits.

Further Reading

- 1 The Contact Lens Manual: a practical guide to fitting. Eds: A. Gasson and J. A. Morris Butterworth-Heinemann, Oxford. 2003.
- 2 Contact Lens Practice. Eds: M. Ruben & M. Guillon. Chapman and Hall Medical, London. 1994.
- 3 Contact Lenses 5th Edition. Eds: A.J. Phillips & L. Speedwell. Butterworth -Heinemann, Oxford. 2006.
- 4 Manual of Contact Lens Prescribing and Fitting, with CD-Rom. 3rd Edition. Ed. Milton.M. Hom. Butterworth -Heinemann, Boston, USA. 2006.