Scleral contact lenses and their therapeutic use – Part 2

Jennifer McMahon describes how to fit scleral lenses. Module C17108, one point for contact lens specialists

As described in Part 1 (*Optician* 01.07.11) there are several major advantages to fitting preformed non-fenestrated scleral lenses (ScCLs), in particular that the endpoint to the initial fitting process is reached quickly and without the need for adaptation. This has been shown to be straightforward and predictable[1,2] compared to any other method and should now be regarded as the first choice ScCL option. The majority of ScCL indications can be fitted with a preformed, non-fenestrated RGP scleral of some type.[3] Therefore this article focuses on the relevant fitting techniques.

Preformed non-fenestrated lenses

Design

The back scleral radius (BSR) and total diameter (TD) are variables which need to be kept constant for a range of optic zone designs in order to vary corneal clearance. The optic zone may be defined either by:

- Optic zone sagitta: combinations of BOZRs and BOZDs are used to vary to sagittal depth.[4] The early design for the limbal zone was a transcurve, but more modern designs are aspheric
- Optic zone projection (OZP): corneal clearance is varied by altering the forward projection of the optic zone from the extrapolation of the scleral curve at its apex without reference to the BOZR or BOZD.[5] The limbal zone is an aspheric curve and may be specified by projection from the extrapolation of the scleral plane at the edge of the optic (Figure 1).

Insertion and removal

The lenses are inserted filled with preservative free saline to create an air-free fluid reservoir between the lens and the eye.

- Position the patient bending forwards with face parallel to the floor and looking down towards the chin (Figure 4a)
- Lift the upper lid and gently slide the lens under towards the upper fornix and support the lens in this position (b)
- Use the other hand to bring the upper lid down to cover the whole of the lens and secure it into the upper fornix
- Keep the lid held down over the lens (c) and pull the lower lid down (using a tissue to dry the lower lid if necessary) until the lens (d) pops into the lower fornix. Gently release both lids
- Patient sits straight with chin up and eyes down
- Lift the upper lid from the nasal side above the edge of lens. Holding the lid at the margin, keep it close to the globe and draw it slowly across the top of the lens to break suction. The lens should pop forward and out (e-f)
- Alternatively a sucker may be used.

Assessment of the lens *in situ*

The lens is inserted filled with saline and fluorescein so that clearance can easily be distinguished from contact. The parameters can be assessed simultaneously but the most appropriate BSR should be determined early on in the fitting process as alterations to the scleral zone later on will have an impact on an optimised optic zone clearance.

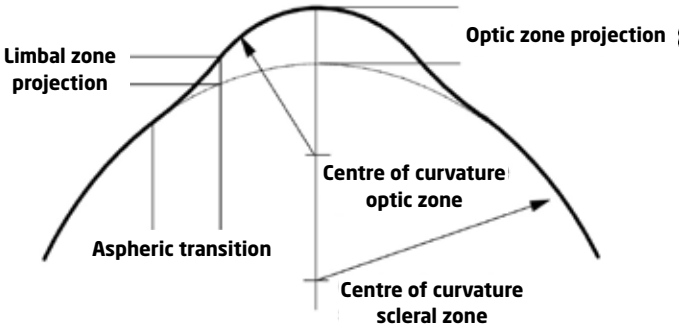
Scleral zone

The sclera is known to have an irregular topography,[6] therefore perfect scleral alignment is unlikely to be achieved with preformed ScCLs. However, a satisfactory degree of alignment to create an effective seal is usually possible. If the BSR is too flat or too steep, the conjunctival vessels can be occluded, giving an appearance of blanching. This is best seen with a broad, white beam viewed without the use of the eyepieces. If far peripheral blanching is unacceptable (Figure 5a), the lens is significantly decentred or there is excessive vaulting of the sclera (Figure 5b) then a flatter BSR can be tried. If mid peripheral blanching is excessive (Figure

FITTING OBJECTIVES

Region of lens	Objective	Notes
Scleral zone	Alignment	The bearing surface of the lens should be spread as evenly as possible over the sclera. A steeper scleral zone fitting moves the bearing surface towards the periphery, a flatter scleral zone fitting brings it closer to the limbus. It must create an effective seal in order to prevent the introduction of air bubbles but minimise compression of the ocular structures beneath
Limbal zone	Clearance	The lens should demonstrate clearance at, and extending beyond, the corneo-limbal juncton in order to avoid compression of the delicate and complex structures at the limbus and reduce the risk of hypoxic events
Corneal/optic zone	Clearance	The lens should be clear of the cornea in all locations. A lens fitting very close to the cornea may reduce comfort and tolerance, while an excessively clear lens may not give optimal visual acuity and may not retain an air-free fluid reservoir. Uniform clearance is unlikely when fitting irregular corneas but corneal contact should be minimised as far as possible

Figure 1



INITIAL TRIAL LENS SELECTION

Parameter	Notes
Total diameter	The issue of ScCL TD was discussed previously but is initially influenced by the size of the eye in question or by practitioner preference. It is the author's preference to try a full diameter ScCL (23mm) in the first instance unless the size of the palpebral aperture renders this inappropriate or in unilateral applications
Back scleral radius	There is no way of measuring scleral topography beyond a maximum of 16mm, which is possible with current OCT equipment, so it is necessary to inspect a lens of known parameters *in situ* to assess the optimum BSR. A steeper BSR is a sensible starting point as it shifts the bearing surface away from the limbus compared to a flatter BSR and provides more corneal and limbal clearance (Figure 2)
Optic zone	Keratometry and digital topography are of little value in estimating the required optic zone clearance as they do not relay any information about the relationship of the corneal profile to the scleral/limbal profile. The sag or OZP for an initial trial lens must be selected from an assessment of the overall corneal profile with the naked eye (Figure 3). The fitting characteristics of the first lens may then be used to select subsequent lenses

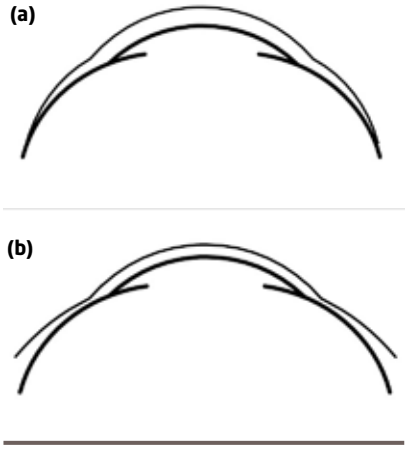


Figure 2 (a) Steeper BSR increases limbal and corneal clearance; (b) Flatter BSR bears closer to limbus and reduces potential for limbal clearance

Figure 3 When assessing the corneal profile eyelids should be held back as far a possible; (a) Central apex, mild distension requiring a shallow OZP; (b) Central apex, moderate distension requiring a medium OZP; (c) Central apex, advanced distension requiring a steep OZP

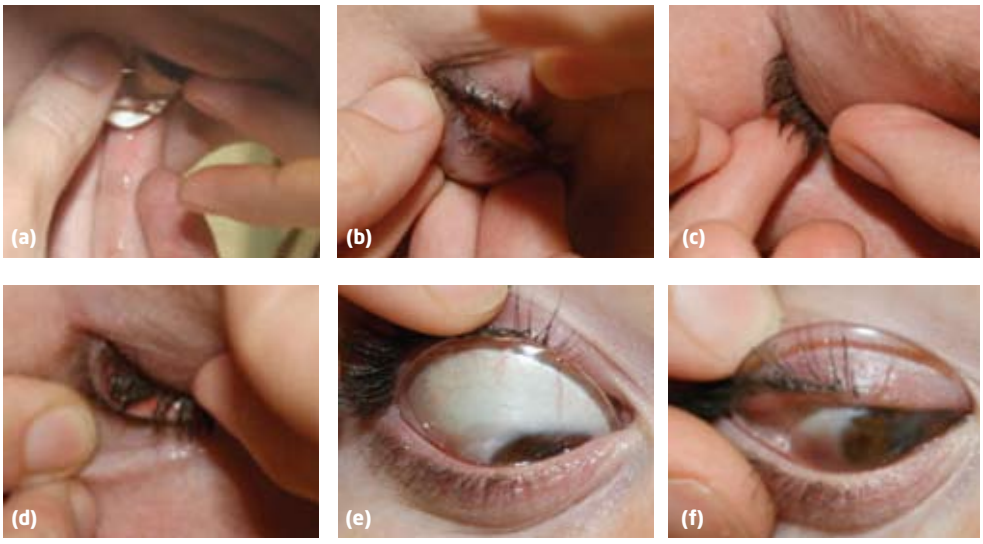


Figure 4 Insertion and removal

5c), there is stand-off at the edge of the lens or there is congestion at the limbus, the BSR is too flat. It is not unusual to see sectorial blanching (Figure 5d) due to the irregular nature of the sclera or to see transient/exaggerated blanching due to movement away from primary gaze. In contrast to corneal lenses a flatter BSR tightens the periphery.

Optic zone

A broad, cobalt blue filtered beam can be used for an immediate observation of fitting characteristics. A heavy corneal contact zone where the corneal shape is effectively altered by the back surface of the ScCL may be referred to as compressive contact which will be seen as a well defined dark blue area (Figure 6a). Light contact where there is no significant impact on the cornea may be referred to as glancing contact and will be seen as a lighter blue, less regularly shaped area demarcated from the fluorescein by feathery edges (Figure 6b). The number of clinical steps required to achieve corneal clearance is dependent on the topographical orientation of the cone apex as well as its distension from the scleral plane.

Once full corneal clearance is established (Figure 6c), a white light optical section can be used to quantify and optimise optic zone clearance (Figure 7). The depth of the pre-corneal reservoir is ideally 0.25mm ±0.1mm and can be estimated by comparison to the corneal thickness. Assuming corneal thickness to be 0.5mm the approximate thickness of the tear layer at the centre and at other significant points across the optic can be estimated.

Preformed, non-fenestrated ScCLs have a tendency to decentre infero-temporally due to the lens weight, eyelid effects and the flatter nasal sclera contour (Figure 8). If the amount of decentration is unacceptable contact then the following should be assessed:

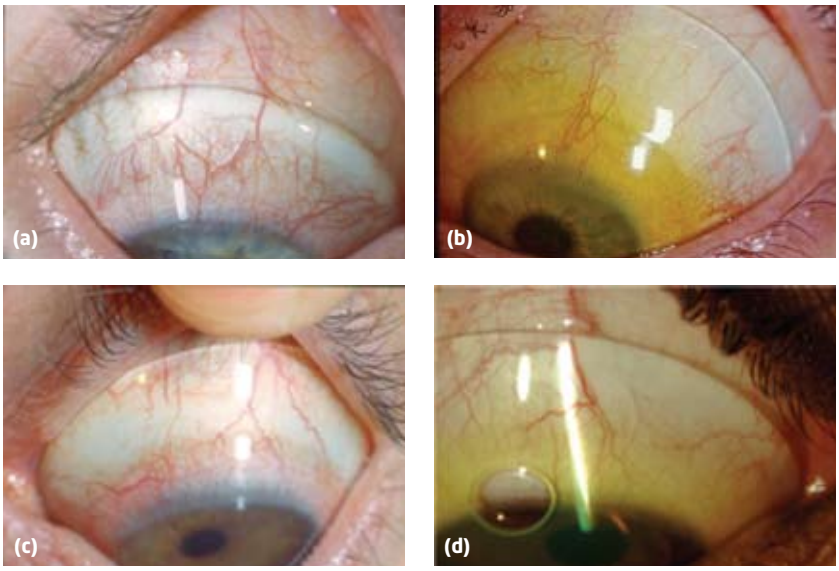


Figure 5 (a) Peripheral compression from steep BSR; (b) Excessive vaulting from steep BSR; (c) Mild peripheral scleral compression from flat BSR; (d) Localised slceral compression from toric scleral fit

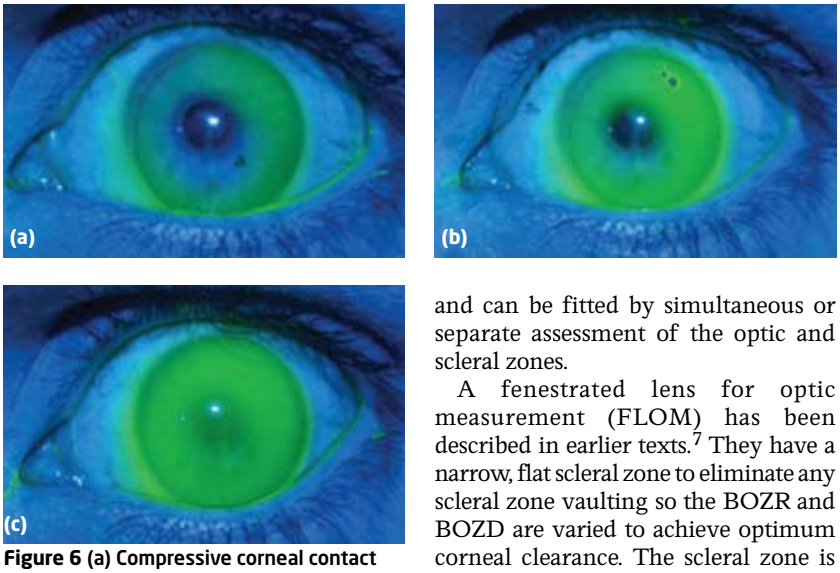


Figure 6 (a) Compressive corneal contact (b) Glancing corneal contact (c) Corneal clearance

- Ensure apical clearance is not excessive
- Try flatter BSR
- Try a reduced diameter.

Limbal zone

When assessing with a broad, cobalt blue beam ideally the fluorescein should extend approximately 2mm beyond the optic to ensure adequate limbal clearance. Adequate clearance can also be confirmed by optical cross section (Figure 9). The aspheric transition can be altered by request to increase or decrease clearance at the limbus if necessary (Figure 10).

Preformed fenestrated lenses

Traditional fenestrated preformed lenses may be indicated in some cases and can be fitted by simultaneous or separate assessment of the optic and scleral zones.

A fenestrated lens for optic measurement (FLOM) has been described in earlier texts.[7] They have a narrow, flat scleral zone to eliminate any scleral zone vaulting so the BOZR and BOZD are varied to achieve optimum corneal clearance. The scleral zone is assessed using a range of lenses with a known BSR and excessive optic zone clearance to avoid any corneal contact during the fitting stage. The final specification amalgamates the scleral and the optic zone parameters.

The disadvantage of independent scleral and optic zone fitting is that the final lens with the combined parameters may show different behaviour on eye compared to its component parts and this cannot be seen until the dispensing stage.

Wide angle lenses[8] allow simultaneous assessment and have been used successfully for many years in the fitting of PMMA fenestrated ScCLs. They have a spherical BOZR and BSR with a tangential junction and conical transition and are defined in terms of corneal and limbal chords (Figure 11).

While the fitting objective is similar to non-fenestrated lenses in terms of the scleral zone, much less, if any, corneal clearance is expected. There is also a greater potential for a settling back effect, hence this lens style may work well for normal topographies but is less successful for very irregular profiles.

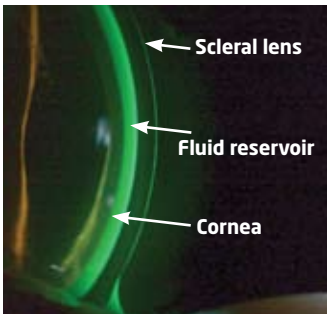
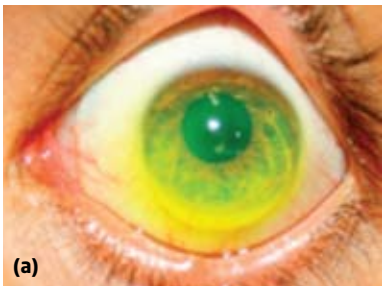


Figure 7 In this example the clearance is relatively uniform from top to bottom. It appears to be almost equal to the corneal thickness and would therefore be recorded as 0.5 in the superior central and inferior locations



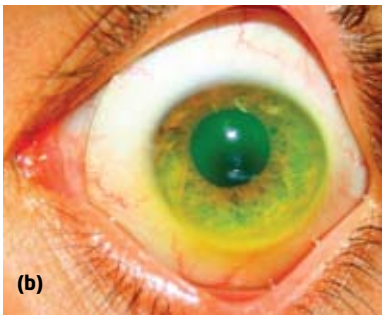


Figure 8 (a) Inferior decentration with steeper BSR; (b) Improved centration with flatter BSR

Impression lenses

In some cases fitting with preformed lenses is not possible and it is necessary to produce a ScCL from the basis of an eye impression. The main indication is poor sealing of the scleral zone allowing air bubbles into the fluid reservoir during wear or unacceptable compression on the sclera. An impression ScCL gives the closest possible match to the scleral topography and the corneal profile. Substance can be removed from the optic zone to create the necessary clearance. Lenses are available in PMMA and RGP materials, with or without fenestration. The clinical and manufacturing processes are complex and beyond the scope of this paper which is dedicated to the now mainstream preformed clinical methods.

Aftercare

Although there is minimal settling back effect with non-fenestrated lenses, it

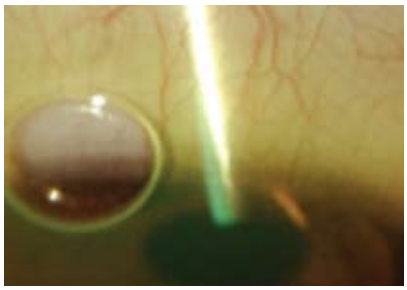
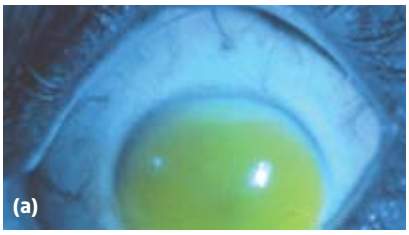
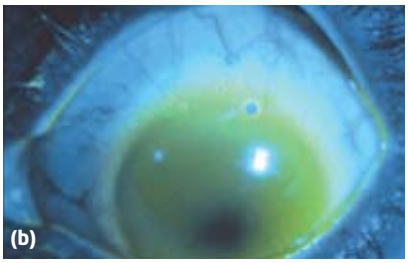


Figure 9 Limbal clearance





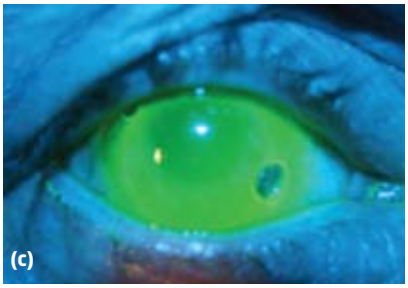


Figure 10 (a) Tight limbal fit improved with 'open' limbal design (b) (c) Excessive limbal clearance improved with 'closed' limbal design (d)

is important to assess the lens after a period of wear to ensure that adequate clearance is present at all times. This means that it will need to be assessed without fluorescein requiring some practice in distinguishing boundaries. The lens can be removed and reinserted with fluorescein if necessary to clarify or confirm any unclear features.

Visual acuity should, for the same reason, be measured prior to removing the lens and again after reinsertion with fresh saline. Power modification should only be considered if over-refraction is repeatable under both circumstances. The normal examinations for hypoxic corneal changes should always be carried out.

In the author's experience, the most common patient concerns at aftercare are poor wetting of the front surface which is best addressed by the use of an alcohol-based cleaner and the build-up of mucus on the inner surface which may be tackled by reinsertion with fresh saline or the use of a more viscous agent. ●

● Readers interested in a two-day scleral lens course should contact 01992 559001 (Innovative Sclerals).

MULTIPLE-CHOICE QUESTIONS – take part at opticianonline.net

1 What is the optimal corneal clearance for a non-fenestrated RGP ScCL?
A Less than 0.1mm
B Between 0.15 and 0.35mm
C 0.5mm
D Equal to corneal thickness

2 Which of these statements is incorrect regarding a flatter BSR?
A It brings the bearing surface closer to the limbus
B It loosens the fit
C It can help improve centration
D It reduces limbal clearance

3 Which of these statements is incorrect about scleral zone fitting?
A Alignment is the objective
B Blanching of the conjunctival vessels is due to compression
C Localised blanching is rare
D Its role is to create a seal and prevent the entry of air bubbles

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Deadline for responses is September 1 2011

4 Which of the following statements is correct regarding limbal zone fitting?
A Alignment is the objective
B There should be clearance equal to corneal thickness
C Fluorescein should extend no more than 2mm beyond the limbus
D Clearance may be varied by changing the BSR, the TD or the design

5 Which of the following is correct with regard to impression ScCLs?
A They are made in PMMA only
B They are always fenestrated
C They are an alternative when a preformed lens fails to seal
D They are the first choice ScCL for the majority of cases

6 Which of the following is incorrect?
A The fit should be assessed without fluorescein before removing the lens
B The lens should be inserted using preservative free saline
C Over-refraction should only be performed after reinsertion of the lens
D An alcohol-based cleaner may improve front-surface wetting

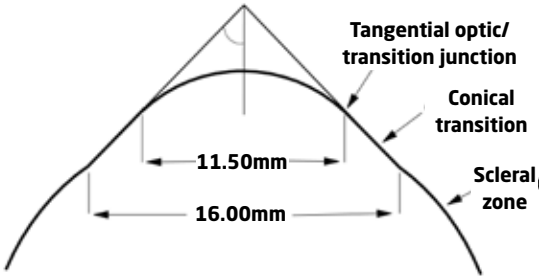

Figure 11 Wide angle lens design

Acknowledgement
Figures 3, 5 abc, 7 and 10 ab courtesy of Ken Pullum.

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● **Jennifer McMahon** is a specialist optometrist at Oxford Eye Hospital and clinical consultant to Innovative Sclerals