Guide to the slit lamp

The slit lamp biomicroscope allows examination of the eye using varying illumination and magnification powers to give a detailed stereoscopic view of the anterior segment. It can also be used in conjunction with other instruments or lenses for checking the intraocular pressure or viewing the posterior segment (vitreous and retina). This article works best if it is re-visited with a slit lamp at hand.

There are different models of slit lamps, but the principles are the same. The one shown in *Figure 1* is one of the most popular models in the UK (the Haag-Streit BM900, Bern, Switzerland). It essentially consists of an illumination system, an observation system and a mounted table with the patient positioning frame.

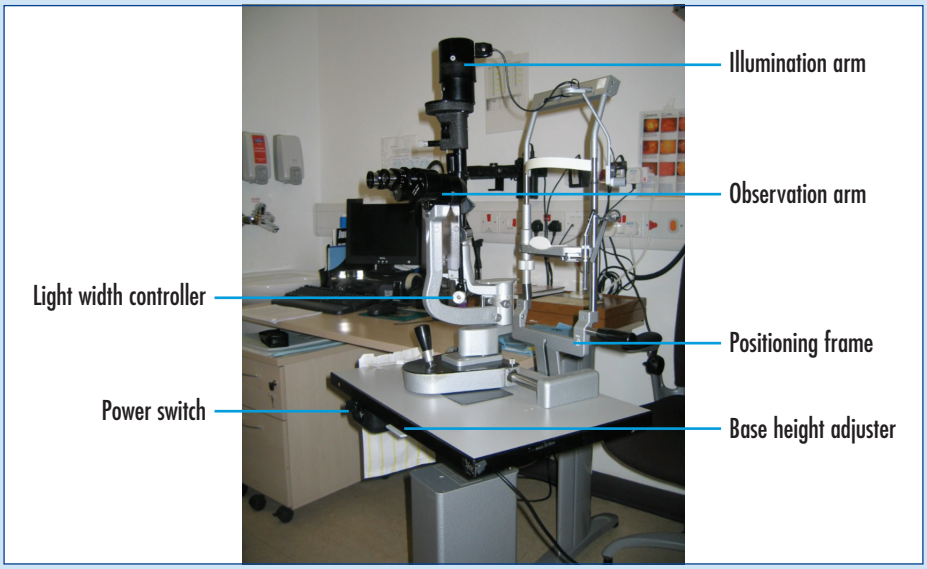


Figure 1. The slit lamp.

The illumination system

At the top of the illumination arm is the 'housing' which contains the light source. Below that is a lever which selects the light filters (*Figures 2a* and *b*). On the above model these are as follows:

Light filters

A: No filter

This setting gives the brightest light (but is not present in all models).

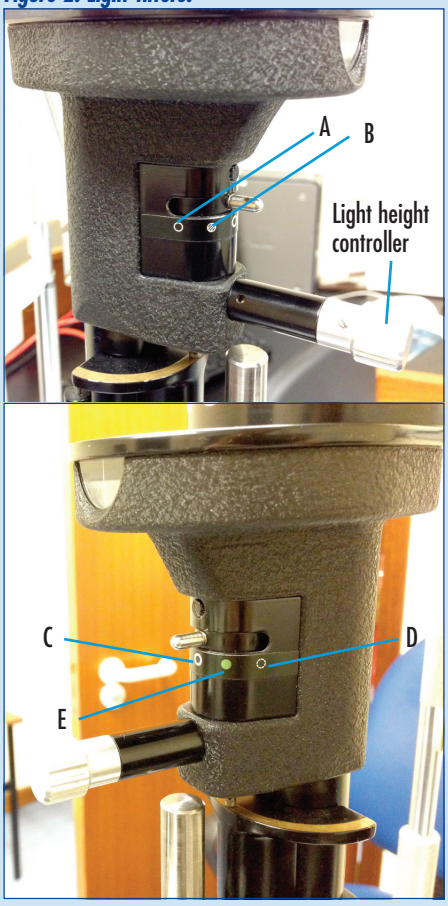
B: Heat reduction filter

This reduces the heat without reducing the intensity of light. In practice this is used most often.

C: 10% neutral density filter

This reduces the intensity of light, so it is more comfortable for the patient and the examiner. It is used to examine the conjunctiva, lids and to take an overall view of the anterior segment (*Figure 3*).

Figure 2. Light filters.



D: Red free (green) filter

This is useful for the experienced user, for example in examining the nerve fibre layer.

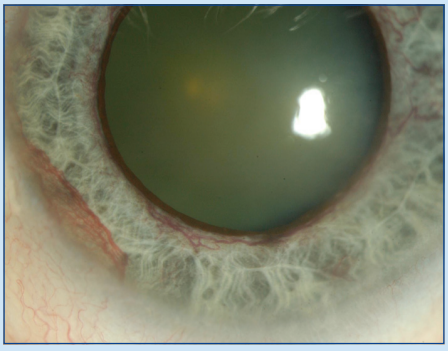
E: Empty

This allows an extra filter to be fitted.

The cobalt blue filter

This is found either to the left of the above set of filters or by turning the light height knob anticlockwise until it clicks and the letter B appear on the display. It is used in examination of the cornea, after the instillation of fluorescein drops, where epithelial defects will be seen as bright green. *Figure 4* shows the deep fluorescein uptake of a corneal ulcer.

Figure 3. Iris neovascularization (rubeosis iridis) with diffuse low density illumination. This is a complication of uncontrolled diabetic eye disease or ischaemic central retinal vein occlusion.



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Light height

Below the light filters is a controller which is used to vary the height of the light (*Figure 2*). Most examinations are done with the light at maximum height. You can use the light height as a measure to give dimension to lesions seen on examination.

Light width

By turning either of the two controllers at the base of the illumination arm (*Figure 5*) the width of the light varies from 0 to 8 mm wide. The slit light is what gives the machine its name and most of its unique characteristics. *Figure 6* is an example of an oblique slit beam showing a cataract.

The viewing system

This comprises changeable eyepieces or oculars (*Figure 7*), and objective lenses to give different magnifications. The net magnification power is the multiplication of the two. Most examinations are performed with an eyepiece lens of 10x and objective lens of 1x. For a higher magnification, the objective lens can be changed to 1.6x by using the lever below the oculars or a dial on the frame depending on the make of the slit lamp. (*Figure 8* shows Lisch nodules using high magnification of 10x1.6.)

Before you start using the slit lamp always check that the eyepieces are pushed properly into place and their refractive correction is dialled to 0 or your own refractive error (see later). If the previous user of the machine is inexperienced, he/she may have unwittingly changed the refractive correction on the eyepieces, making it very difficult for you to focus unless you reset it.

The viewing system has a fixed focal distance, so to focus anteriorly or posteriorly, the viewing system must be moved backward or forward respectively.

Both illumination and viewing arms can move separately but the two systems are 'coupled'. This means that when you are focussed on an area within the viewing system, the illumination falls within this area too. For general use of the slit lamp, the decoupling knob (*Figure 9*) should be turned all the way clockwise otherwise this function does not work.

The base and the patient frame

The joystick is located on the instrument base. This allows the two arms to be moved together in all directions. Up and down movements are performed by rotating the joystick.

The patient's frame has a chin rest, forehead band and, in some models, hand rests. These three areas are in direct contact with the patient so should be disinfected after each examination. The chin rest moves up and down by turning an adjuster on the frame to the right or left (*Figure 10*). The base itself moves up and down using a controller on the base which is either manual or automated depending on the model (*Figure 1*).

The slit lamp moves on a track, near the end of which there is a small locking knob (*Figure 11*), which is used to prevent the machine from sliding forward.

Figure 4. Corneal ulcer (bacterial keratitis) after the instillation of fluorescein drop and viewed using the cobalt blue filter.

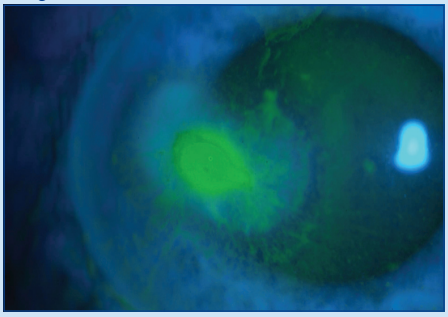


Figure 5. Light width controllers.

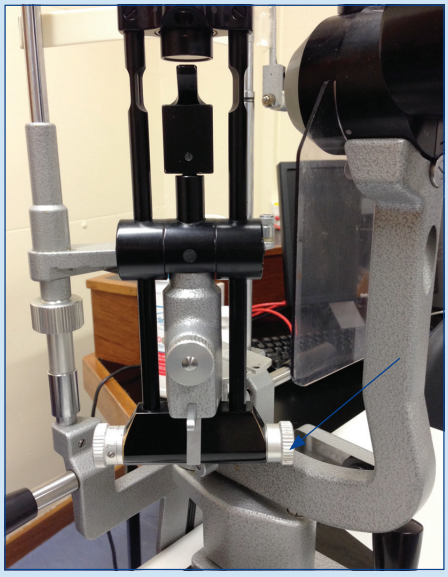


Figure 6. Cataract using a narrow beam.

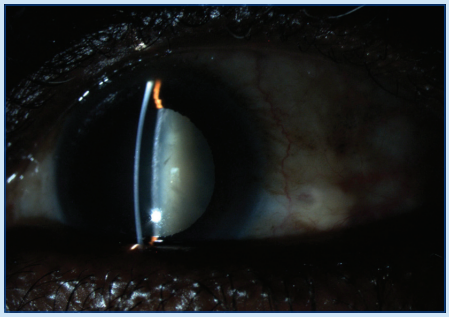


Figure 7. The oculars.

Figure 8. High magnification image of the iris showing Lisch nodules found in neurofibromatosis 1.

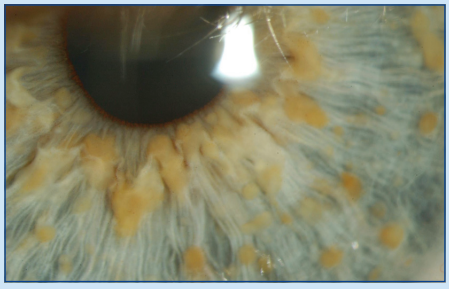


Figure 9. The decoupling knob.

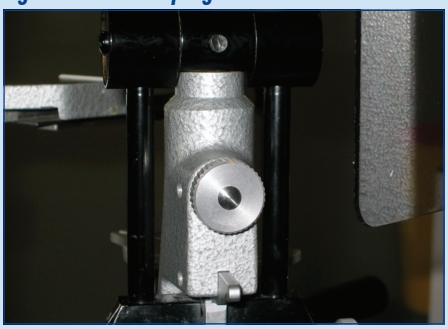
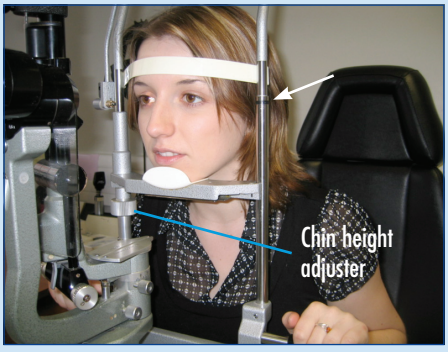


Figure 10. Patient position on the slit lamp. Note that the lateral canthus is in line with the black mark on the frame (white arrow).



Also on the base there is the on/off and voltage control. The light source in the slit lamp usually has two, three or more voltage settings (*Figure 12*). The lower setting is most often used, but higher voltage is essential in assessing the anterior chamber for cells and flare.

Setting the machine

If you wear glasses you can wear them while using the slit lamp, or you can adjust the eyepiece's power to compensate for your refractive error. In order to find the most comfortable and best lens power for you, you will need to use the focusing rod, which you usually find in the drawer of the slit lamp. Adjust the power of the oculars, one eye at a time, until you have the clearest view (*Figure 13*).

Before you start turn the lens to a high plus (e.g. +5.0) and while observing the rod with one eye turn the power slowly clockwise towards zero. Always opt for the most plus or least minus power that gives you a clear image as this will relax your accommodation. Once you have decided on the best power for you, remembering it will allow you to easily set the slit lamp each time you use it.

In order to achieve a binocular, stereoscopic view, it is important to adjust the inter-pupillary distance. This is simply done by turning the oculars in or out until a clear single image is seen with both eyes open.

Figure 11. The locking knob.

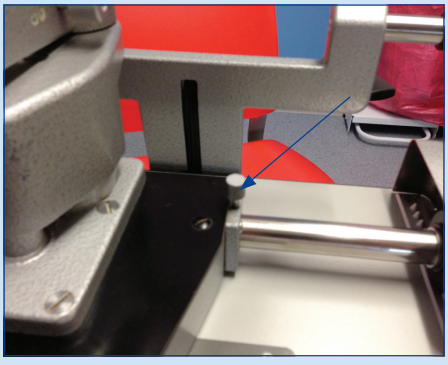


Figure 12. The voltage box.

Preparing the patient

- Explain the procedure to the patient.
- Always wipe the chin and forehead rests with an alcohol wipe between patients.
- The most important sentence is: 'Please put your chin on the chin rest and forehead against the band'. Patients will naturally drift backward during the examination so you have to remind them to keep their position.
- Adjust the height of the chin rest so that the lateral canthus is in line with the black line on the patient frame. This step is very important (*Figure 10*). Make sure the patient is comfortable and is neither bending nor stretched. (Ask and observe.)
- Always begin the examination with low voltage and narrow light and expand slowly. Opening a high voltage light suddenly is very uncomfortable.
- A young child can either kneel on the chair or can simply stand up if he/she is tall enough.
- Patients who are obese or who have a large bust should be asked to sit up to the back of the chair as much as they can and lean forward. They may need help in supporting the head and they may need a break if the examination is prolonged.

Methods of illumination

The slit lamp produces six different illumination techniques. The last two require some practice, but most examinations use the first three.

Figure 13. The focusing rod. Focus one eye at a time.

Diffuse beam

This is used to obtain a 'gross' image with full width beam, mainly used to examine the conjunctiva and adnexa (*Figure 14*). It is also used to evaluate corneal staining with fluorescein using the cobalt blue filter (*Figure 15*).

Focal illumination

Focal illumination is performed by using a slit beam of light to take an optical section. The illumination arm is usually set at a 45° angle from the viewing arm although the angle should be dynamic to give a better idea of the depth of the pathology. Starting with a 2 mm wide slit beam gives good information about the cornea (*Figure 16*). Narrowing the beam further helps to determine the depth of the pathology or the thickness of the cornea more precisely (*Figures 17–19*).

Figure 14. Subconjunctival haemorrhage with diffuse illumination.

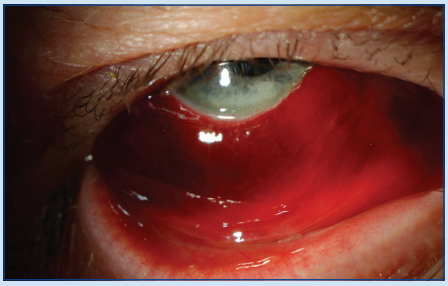


Figure 15. Peripheral ulcerative keratitis using cobalt blue filter and diffuse illumination.

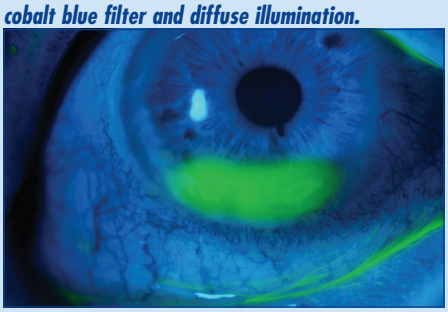
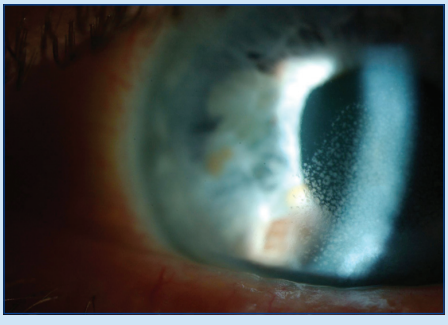


Figure 16. Focal illumination showing keratic precipitate which are cellular deposits on the endothelium of the cornea in anterior uveitis.



A narrow beam of 1 mm width (conical beam) is used to see cells and flare (protein exudates) in the anterior chamber in uveitis. The idea is akin to a cinema light beam illuminating dust particles in the air. Using fine movements of the joystick, the viewing system should be focussed on the anterior chamber (i.e. both cornea and iris will be blurred). By convention a beam with 1 mm height, 1 mm width and maximum illumination and magnification (in a reasonably dark room) is used to grade cells and flare to assess severity and response to treatment in anterior uveitis (*Figure 20* and *Table 1*).

Figure 17. Narrow thin beam at acute angle to viewing arm focusing on the peripheral cornea in anterior scleritis. The arrow points to the associated corneal thinning (corneal melt) – a subtle sign but important because of risk of perforation.

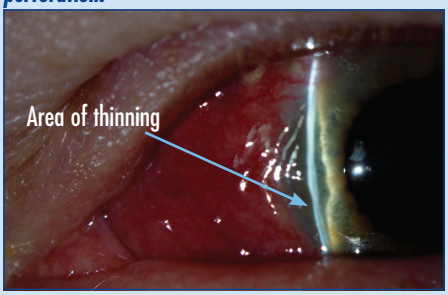


Figure 18. Slit beam showing a very shallow anterior chamber. This is a risk for developing angle closure glaucoma.* Figure 19 *gives a comparison.

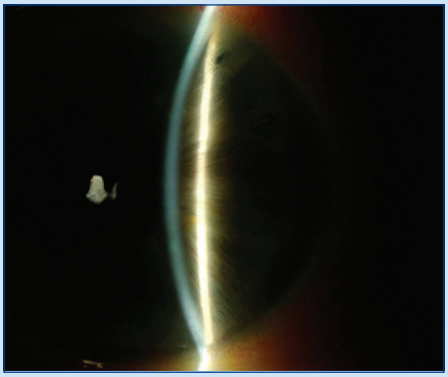
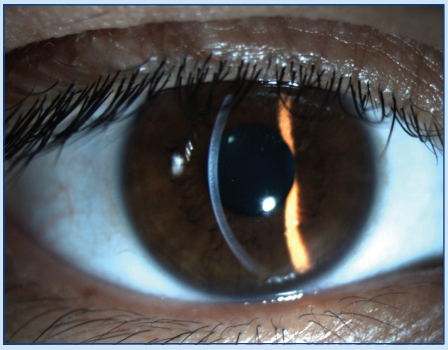


Figure 19. Slit beam showing normal depth anterior chamber (compare with* Figure 18*).



Indirect illumination

The focal beam can also be used to indirectly illuminate corneal lesions by simply directing the light just to the side of the area to be studied (*Figure 21*). With experience direct and indirect illumination can be performed at the same time.

Retro-illumination

In this method light is reflected from a deeper structure to examine a more anterior structure. It is a little tricky to master. It is used to examine the cornea (e.g. subtle oedema) by using an angled beam aimed at the iris and reflected onto the cornea. However, to examine the iris and/or lens by this method, use a coaxial (i.e. straight, not angled) beam smaller than the pupil size aimed at the retina. Once you get the red reflex, pull the joystick backward focusing reflected light on these structures (*Figure 22*).

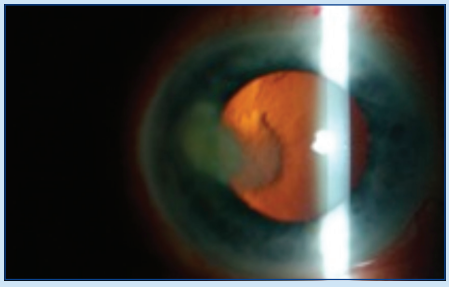
Figure 20. Cells and flare in the anterior chamber in acute anterior uveitis (iritis).

Table 1. Grading of anterior chamber cells and flare

	Cells	Flare
0.5+	1–5	
1+	6–15	Faint
2+	16–25	Moderate (iris and lens clear)
3+	26–50	Marked (iris and lens hazy)
4+	>50	Intense (fibrin)

from Denniston and Murray (2009)

Figure 21. Corneal ulcer using indirect illumination.



Specular reflection

This is mainly used to examine the corneal endothelium using high magnification. The angles of incidence and reflection should be equal.

Sclerotic scatter

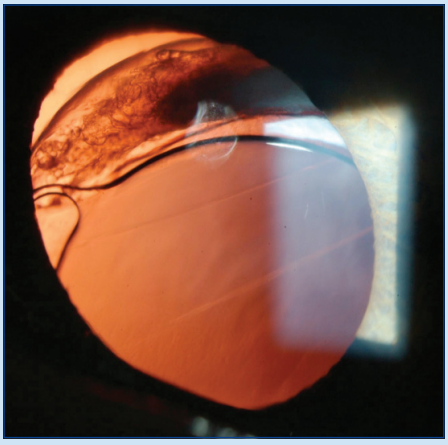
This method mainly depends on decoupling the illumination and viewing system. It is used to detect and assess subtle corneal abnormalities.

The examination routine

First examine the adnexa (lids), conjunctiva and sclera with low voltage and diffuse beam. Use the same setting to give an overview of the cornea and iris. Then use a focal beam with moderate voltage to examine the cornea by direct and indirect illumination as explained above. Examine the anterior chamber, iris and lens using focal then retro-illumination. Instill a drop of fluorescein and change the light to blue to examine for corneal epithelial defects and tear film stability (*Figure 23*). Proceed with examination as indicated by the history and initial findings.

Slit lamp examination is a two-handed job. For the best control have one hand on the joystick and the other hand on the base of the illumination arm. The latter will control the width of the beam as well as the angle between viewing and illumination.

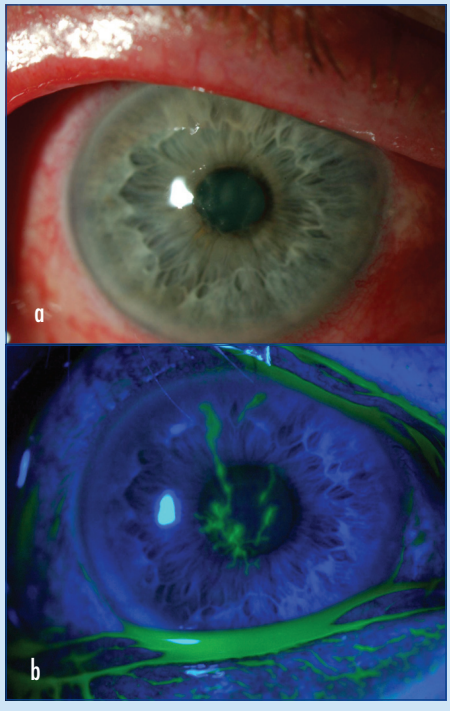
Figure 22. Retroillumination showing inferiorly dislocated intraocular lens implant.



Removing a corneal foreign body

You could try using a wet cotton bud, but you will need to master using a needle (e.g. 25 G orange) to remove a metal foreign body that has been there for a day or more. Give very clear instructions to the patient not to move his/her eyes or blink forcefully. Give topical anaesthesia until the patient cannot feel the drops going in. For the beginner, it is safer to position the tip of the needle tangentially on the cornea in such a direction that if the eye is moved inadvertently, no penetration of the cornea will occur.

Figure 23. a. Patient examined using diffuse beam not sufficient to show the corneal pathology for the inexperienced examiner. b. In the same patient, a dendritic ulcer is easily highlighted after instillation of fluorescein, using the cobalt blue filter.



Seidel test

Instill a drop of 2% fluorescein and use the cobalt blue light (*Figure 24*). If there is a leaking wound (e.g. penetrating eye injury) the leaked aqueous will dilute and therefore disturb the smooth green fluorescein uptake. The dilution extends downward with gravity.

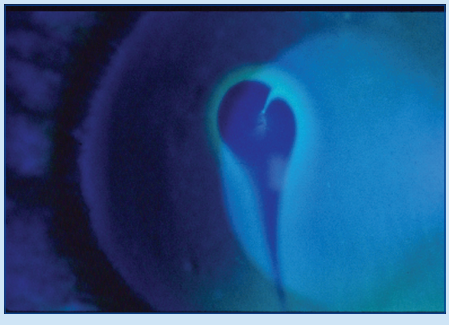
Machine maintenance

The two most common factors that cause the bulb to blow before its working life ends are suddenly turning the bulb straight to the high voltage and leaving the light open after examination.

Replacing the bulb is simple. Disconnect the mains. Open the two knobs on the housing compartment, take care, as the bulb will be very hot, position the new bulb correctly, and then close the compartment (*Figure 25*). BJHM

The authors would like to thank Professor Philip I. Murray for his help and guidance in writing this article. Figure 20 *is reproduced with permission from the Keeler website (www.keeler-symphony.com/making-sense) courtesy of Mr Tim Woolley.* Figure 24 *is reproduced courtesy of the American Society of Retina Specialists Retina Image Bank (http://imagebank.asrs.org/file/12692/seidel-test). This image was originally published in the ASRS Retina Image Bank. Mr David Callanan MD, Texas Retina associates. Seidel test. Retina Image Bank. 2013; 12692. © the American Society of Retina Specialists.*
Conflict of interest: none.

Figure 24. Positive Seidel test.



Denniston AKO, Murray PI (2009) *Oxford Handbook of Ophthalmology.* 2nd edn. Oxford University Press, Oxford

Further reading

Ledford JK, Sanders V (2006) *The Slit Lamp Primer.* 2nd edn. SLAK Incorporated, Thorofare
Wilson II FM, ed. (1996) *Practical Ophthalmology: A Manual for Beginning Residents.* American Academy of Ophthalmology, San Francisco

Figure 25. Changing the light bulb. Ensure the power is disconnected.

KEY POINTS

- The slit lamp is easy to use and gets easier with practice.
- Familiarize yourself with the various parts and make sure they are in the correct position before you start.
- Adjust the slit lamp so the patient's lateral canthus is level with the black mark on the frame.
- Ask if and observe that the patient is comfortable.
- Start with diffuse low illumination then use focal oblique beam with moderate voltage for detailed examination.
- Use various illumination techniques to have a better view of the pathology.
- Apply a drop of fluorescein and use the cobalt blue filter to examine for corneal epithelial defects or leaking wounds.