How to conduct a slit lamp examination

Anika Nanda¹, Aachal Kotecha²

Abstract
This article aims to introduce the uses of slit lamp bio-microscopy to medical students and junior doctors, providing a brief overview of techniques. It outlines the skills necessary to set up an examination for each patient. The paper summarises a few vital techniques enabling exploration of each part of the eye from outermost lids and tear film to the retinal layers. Finally, it provides advice on certain sight-threatening signs as well as additions such as filters and lenses, which may be used alongside this instrument. Being proficient in using the slit lamp is important not only in ophthalmology clinics but a valuable asset in accident and emergency.

Keywords: red eye, clinical skills, slit lamp, examination

Introduction
The slit lamp bio-microscope provides the examiner with a stereoscopic or 3-dimensional view of the eye. This joystick-controlled microscope (Figure 1) is found in almost all ophthalmic consulting rooms; an important tool in the assessment of signs, making diagnoses and for monitoring the effects of treatment and continuing prognosis of many ocular complaints.

Each practitioner develops their own slit-lamp routine, but to aid a systematic evaluation of the eye (and to be sure that you don’t miss anything!) it is worth beginning the examination with the anterior-most structures and progressing towards the retina. The slit lamp biomicroscope can be used to assess the eye’s anatomy in detail, by varying the illumination and magnification, as well as with the use of filters (Table 1), topical drugs and stains (Table 2).

Set-Up
Prior to commencing the slit lamp examination, each eyepiece should be focused separately and the interpupillary distance adjusted so that a single, stereoscopic image is obtained. This can be performed with a focusing rod, which can be inserted into the pivot point of the illumination and observation arms, or using a flat surface at a specified distance.

The slit-lamp is constructed of a viewing arm and illuminating arm, both of which should be held simultaneously to ensure full control of the slit lamp biomicroscope.

As with any medical examination, good hygiene practice should be adopted by washing the hands with soap and water and cleaning with alcohol gel between patients. The slit lamp should be cleaned with antisepic wipes to minimise the risks of infection spread.

Adjust the patient’s chair height so that they are sitting in a comfortable position with both their forehead and chin pressed firmly against the rests; adjust the height of the chinrest so that the lateral canthi are level with the markers on the slit lamp. Ideally, the room lighting should be dimmed when you conduct the examination.

Affiliations:
1. Final Year Medical Student, University of Leicester Medical School, Maurice Shock Building PO Box 138, University Road, Leicester. LE1 9HN
2. Senior Research Associate, NIHR Biomedical Research Centre for Ophthalmology, UCL Institute of Ophthalmology, Moorfields Eye Hospital NHS Foundation Trust, 162 City Rd, London. EC1V 2PD

Correspondence to:
Anika Nanda; anikananda@aol.com

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Figure 1 | Diagram of slit lamp bio-microscope. Image drawn by Anna Pouncey.

Table 1 | Filters available on a slit lamp bio-microscope

<table>
<thead>
<tr>
<th>Filter type</th>
<th>Filter Use</th>
</tr>
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<tbody>
<tr>
<td>Cobalt Blue</td>
<td>Used with fluorescein dye during assessment of dry eyes, contact lenses, and Goldmann applanation tonometry.</td>
</tr>
<tr>
<td>Neutral density</td>
<td>Reduces the brightness of the illumination and is complemented by the rheostat on the instrument.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Can be used in addition to the Cobalt blue filter to enhance contrast.</td>
</tr>
<tr>
<td>Red free (green)</td>
<td>Enhances the contrast of blood vessels on the corneas of contact lens wearers and haemorrhages seen under the conjunctiva</td>
</tr>
<tr>
<td>Diffuser</td>
<td>Generally used with a wide beam and low magnification with non-directional illumination for gross assessment of the eye.</td>
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</tbody>
</table>
The patient examination

Try not to jump straight in and use the slit lamp - sometimes, it is the most obvious things that we miss! Looking at the patient as we take a history can give us a wealth of information before we begin formally examining the eye. Can the patient open their eye? Is the patient blinking ‘normally’? Is there a ptosis? Is the face drooped to one side? Are there any lumps or bumps? Is there an entropion/ectropion? Are the eyes yellow/red? Are the eyes watery? These are just a few questions answered with a few glances. If you observe something that looks ‘abnormal’, you should ask the patient if they have noticed it before and for how long they have had that feature.

Ocular adnexa

The ocular adnexa consists of the eyelids, lashes, conjunctiva and sclera. These structures should be assessed using a wide beam with a diffusing filter so that all structures are illuminated, initially at a low magnification. The slit lamp should be slowly moved from left to right in a Z-shaped pattern starting from the upper lateral canthi towards the puncta, ensuring attention is paid to the lashes and the meibomian glands. If necessary (e.g. the patient complains of a foreign body sensation), evert the eyelids to view the palpebral conjunctiva. Ask the patient to look in the 4 directions of gaze (up, down, left, right) to enable a view of as much bulbar conjunctiva and sclera as possible; hold eyelids up or down to get an unobstructed view.

Where possible, grade the intensity of signs observed using appropriate clinical grading scales; for example, conjunctival hyperaemia may be graded using the CCLRU (Cornea and Contact Lens Research Unit) grading scale. Grading a sign is useful as it can give an indication of whether treatment (or lack of) results in change and standardises the subjectivity of ocular signs when multiple practitioners are caring for one individual.

It is also useful to evaluate the pre-corneal tear film; non-invasive techniques should be used before invasive methods. The tear prism height and regularity should be examined initially, followed by an assessment of the quality of the tear film, and finally the ‘tear break up time’, which requires the use of fluorescein and a cobalt blue filter. The puncta should also be examined for adequate drainage. This is especially important in contact lens wearers and those suffering from dry eye.

Table 2 | Stains used in assessing the cornea

<table>
<thead>
<tr>
<th>Stain</th>
<th>Stain Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescein sodium (P)</td>
<td>Use in assessment of tears and cornea for the detection of epithelial lesions and foreign bodies.</td>
</tr>
<tr>
<td>Rose Bengal (P)</td>
<td>Derivative of fluorescein, staining dead or degenerated cells – used mainly in the diagnosis of keratoconjunctivitis sicca.</td>
</tr>
<tr>
<td>Lissamine Green (P)</td>
<td>Similar to rose Bengal but causes less discomfort.</td>
</tr>
</tbody>
</table>

Cornea

The cornea is a multi-layered structure and can be examined with an optical section. In this, the slit beam is narrowed to a width of 1-2 mm and the angle between the observation and illumination arms is kept wide revealing the three distinct layers of epithelium, stroma and endothelium.

A wider, brighter beam, termed parallelopiped can be used to further assess the depth of abnormalities, such as hypoxic corneal infiltrates or foreign bodies.

Observation techniques such as these can prove useful in the detection and location of abnormalities but other techniques such as sclerotic scatter can give information of the overall integrity of the cornea in seconds. To use this method, the illumination system needs to be decoupled from the observation system and the slit light beam of 2-4 mm should be focused on the temporal limbus at an angle of 40-60 degrees; the room lights should be off. In a normal cornea, a halo of light is observed around the limbus, whilst the cornea appears dark. This technique exploits the phenomenon of total internal reflection (TIR), whereby all the light is ‘trapped’ within the cornea, and is only obtained when the cornea is completely transparent, and therefore optically ‘quiet’. In cases where the cornea is compromised, TIR is not obtained and lesions manifest as areas of scattered light (Figure 2A).

Another technique, termed specular reflection, can be used to specifically examine the four interfaces within the eye that have a change of refractive index: that is the pre-corneal tear film and anterior cornea, the corneal endothelium and anterior chamber, the anterior chamber and anterior lens capsule and the posterior lens capsule and the vitreous chamber. This technique, however, is primarily used to evaluate the integrity of the corneal endothelium.
Anterior chamber/iris
The anterior chamber contains the aqueous humour, a fluid produced by the ciliary body which, supplies nutrients to the anterior lens and avascular cornea, after which, it is drained by the trabecular meshwork in the iridocorneal angle. In the normal eye the anterior chamber is ‘dark’ as it is optically empty. However, during pathological break-down of the blood-aqueous barrier, such as in anterior uveitis, inflammatory cells and proteins, travel into the anterior chamber. These can be viewed using a bright narrow beam of 2-3mm height shone at an angle of 40-50 degrees into the eye, viewed at medium-high magnification and focussing between the cornea and the lens. The scatter of light from particles, similar to dust seen in sunlight, is termed the Tyndall effect (Figure 2B).

The width of the iridocorneal angle should also be estimated. Although gonioscopy remains the gold standard, the angle width can be determined using the Van Herick’s technique. Van Herick’s method uses a bright, thin slit beam with the illumination beam locked at 60 degrees temporal to the patient’s eye. The section is focused and placed at the limbus comparing the ratio of thickness of the cornea to the gap created by the cornea and the front of the iris. This is graded and the risk of closure is determined and managed appropriately.

The integrity of the iris may also be examined using retroillumination. Retroillumination is an indirect illumination technique that utilises light reflected from posterior surfaces to view the area of interest (Figure 2C). It is a useful technique to use when direct illumination of the structure of interest results in light scatter and glare, which would otherwise obscure any detail.

Lens
As the practitioner continues to advance the slit lamp further into the eye, the lens comes into view. An optical section of narrow beam width and medium magnification, similar to that when viewing the cornea, shows the distinct layers of the lens. Cataracts can be viewed using this technique allowing the practitioner to distinguish between cortical, posterior sub-capsular and nuclear sclerotic lens opacities (Figure 2D).

Other media opacities can be inspected with the use of the retro-illumination technique. Posterior capsular opacification, a complication of cataract surgery can be viewed in this way, with the reflection of light obtained from the red fundus.

Figure 2 | Signs on slit lamp examination. (A) Sclerotic scatter: Oedematous areas or scarred areas of the cornea scatter light highlighted by the arrows. (B) Anterior chamber cells and flare: Note that the cornea and lens are not in focus. In the ‘normal’ eye, the anterior chamber will appear black, as it should be empty of cellular and proteinous material. (C) Iridodialysis seen using retroillumination technique. Light from the fundus reflects back through the ocular media, highlighting the area of iris trauma at 5 o’clock. (D) Lens section, illustrating lens opacities. Using a thin beam and a wide angle between the observation and illumination arms, focusing on the lens area reveals the location of lens opacities. Images courtesy of Dr Dan Rosser, Norfolk & Norwich University Hospital NHS Foundation Trust.
Vitreous humour and fundus

Many patients complain of floaters in their vision, and this is usually regarded as a normal finding. Floaters represent debris in the vitreous and are usually innocuous, becoming more common with advancing age. However, if the patient reports changes in the number or size of floaters or concurrent flashing lights, this can indicate a more sinister finding.

The anterior vitreous can be viewed just behind the lens; using the narrow optical section, advance the slit-lamp joystick forward through the lens so that it becomes out of focus. Asking the patient to look up, down and then straight ahead causes movement of the vitreous, revealing floaters. This method can also reveal debris released by the retinal pigment epithelium after a retinal break. This observation is termed Schaffer’s sign or informally as ‘Tobacco dust’, and if positive this almost always indicates the presence of a retinal tear which requires further investigation.

The slit lamp may also be used to view the retina. This technique uses a high-power positive lens, ranging from +60 to +90 dioptres, held in front of the patient’s eye, using a small, narrow beam at an angle of less than 5 degrees shone through the pupil area. The choice of lens depends on the magnification, field of view and detail that are desired. The optics of a positive-powered condensing lens creates an image that is both inverted and reversed; therefore, a lesion in the right upper quadrant is projected as an aerial image in the left lower. Filters (Table 1) can also be used at the fundus to highlight abnormalities further. Indirect ophthalmoscopy allows binocular viewing, enabling a three-dimensional images with a larger field of view and is unaffected by refractive power of the patient. However, in many cases dilating drops may be necessary for adequate views to be achieved.

Conclusion

In summary, these are just a few of the specialised techniques used in the slit lamp examination. With experience, procedures can be selected based on the history the patient provides, but this should not obscure the possibilities of other concurrent co-morbid conditions of the eye. It takes practice to master, but using the slit lamp bio-microscope can ensure confident diagnoses.

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**Table 3 | Techniques used in slit lamp examination**

<table>
<thead>
<tr>
<th>Technique</th>
<th>Description</th>
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<tbody>
<tr>
<td>Diffuse illumination</td>
<td>Diffusing filter, wide bright beam and low magnification to examine the ocular adnexa. Slowly swing the illumination system in Z shape formation from left to right.</td>
</tr>
<tr>
<td>Direct illumination using parallelepiped</td>
<td>Low (x10) magnification, 2mm width beam and illumination set at 45 degrees from the viewing system; increase magnification as required.</td>
</tr>
<tr>
<td>Indirect illumination</td>
<td>Same as above, but rather than looking within the area if illumination, look to the areas that are not directly illuminated. Can be used to detect fine blood vessels at the limbus and microcysts.</td>
</tr>
<tr>
<td>Sclerotic scatter</td>
<td>Decouple the illumination and microscope system and place the light beam onto the limbus to see a halo around the cornea. Look for escape of light and incomplete halo.</td>
</tr>
<tr>
<td>Optical Section</td>
<td>Direct illumination technique using low magnification and narrow beam beginning with low magnification and increasing to high. Used to view the cornea and lens.</td>
</tr>
<tr>
<td>Retro-illumination</td>
<td>Create a parallelepiped beam of 1-2mm width, low magnification and lock the joystick when the abnormality is in focus. Decouple the illumination system and direct the light onto the iris or the fundus, depending on the location of finding to enable viewing of the structure from behind. Can also be done without decoupling the instrument.</td>
</tr>
</tbody>
</table>
References

2. Kotecha A. Ophthalmic clinical skills Topic 7: Miscellaneous slit-lamp skills; Focusing the slit-lamp, 2010.

LEARNING POINTS

- Perform a gross external eye examination prior to conducting a slit lamp examination, so that you do not miss any pertinent signs.
- Ensure that the slit-lamp is correctly focused so you have a stereoscopic view of the eye.
- Ascertain the patient is comfortable prior to examination.
- Familiarize yourself with the filters and beam control features before you start, as each slit-lamp is different.
- The illumination and observation arms can be manoeuvred to get optimal view of all ocular structures.