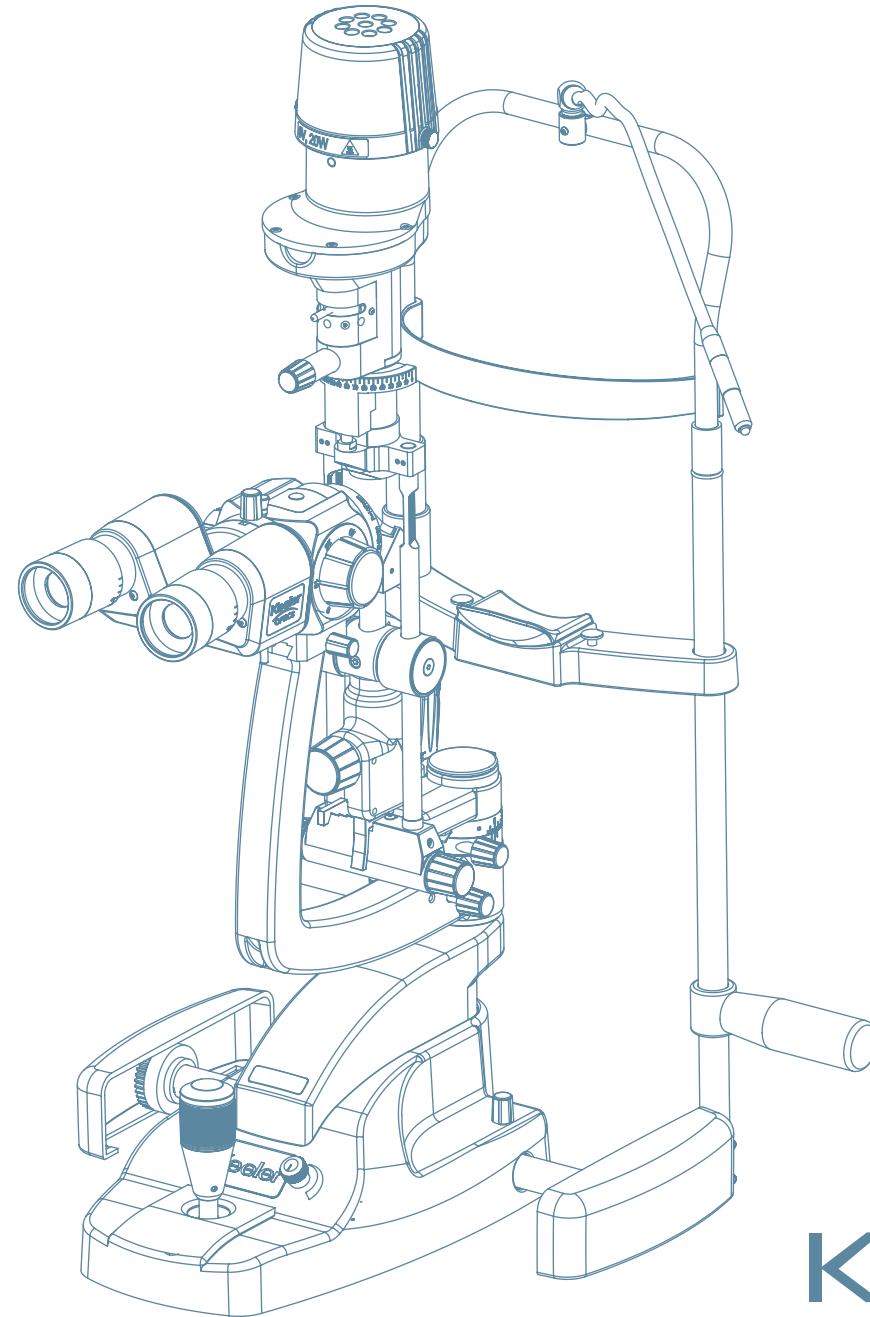


MAKING
SENSE OF...

SLIT LAMPS AND THE HUMAN EYE



Slitlamp
by Keeler

Keeler

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ANATOMY OF A SLIT LAMP

Fixation target

Filter lever

Slit length & slit rotation

Yellow filter

Magnification change

Slit offset centring knob

Slit Inclination latch

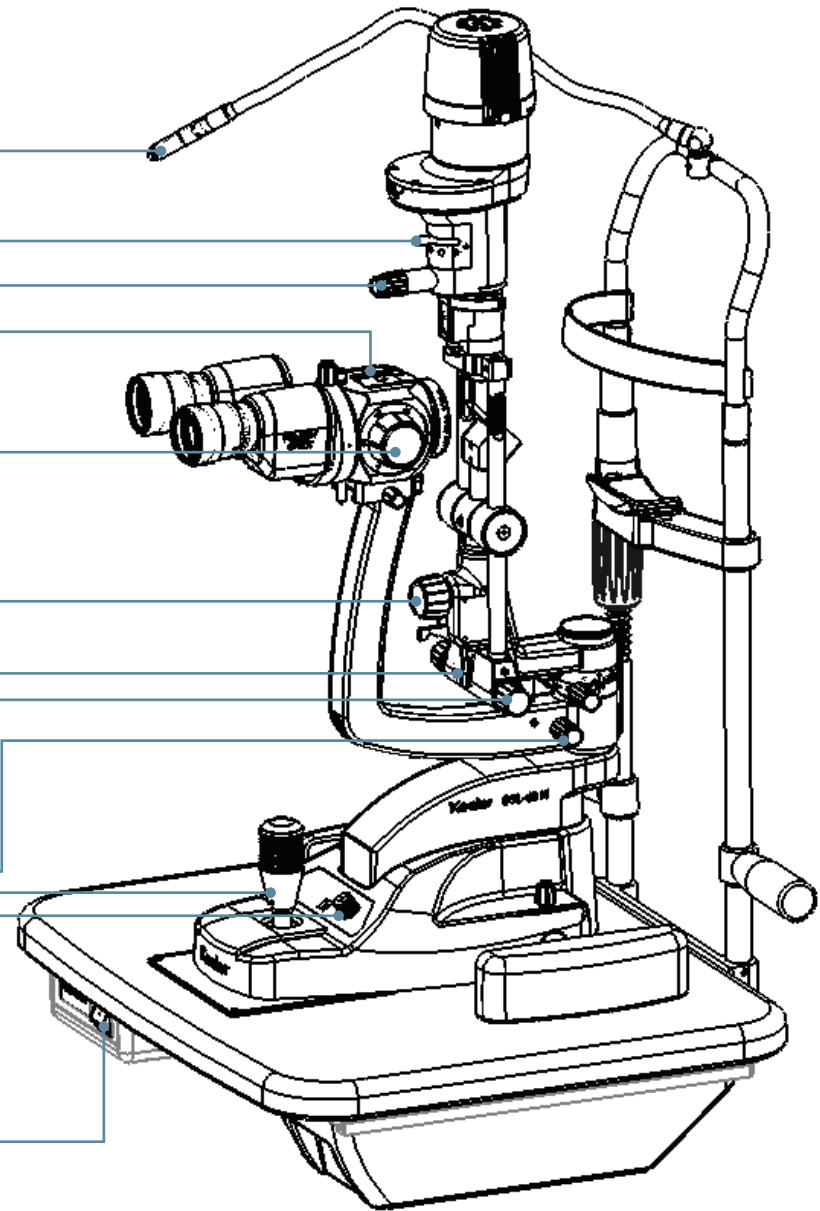
Slit width control

Locking knobs

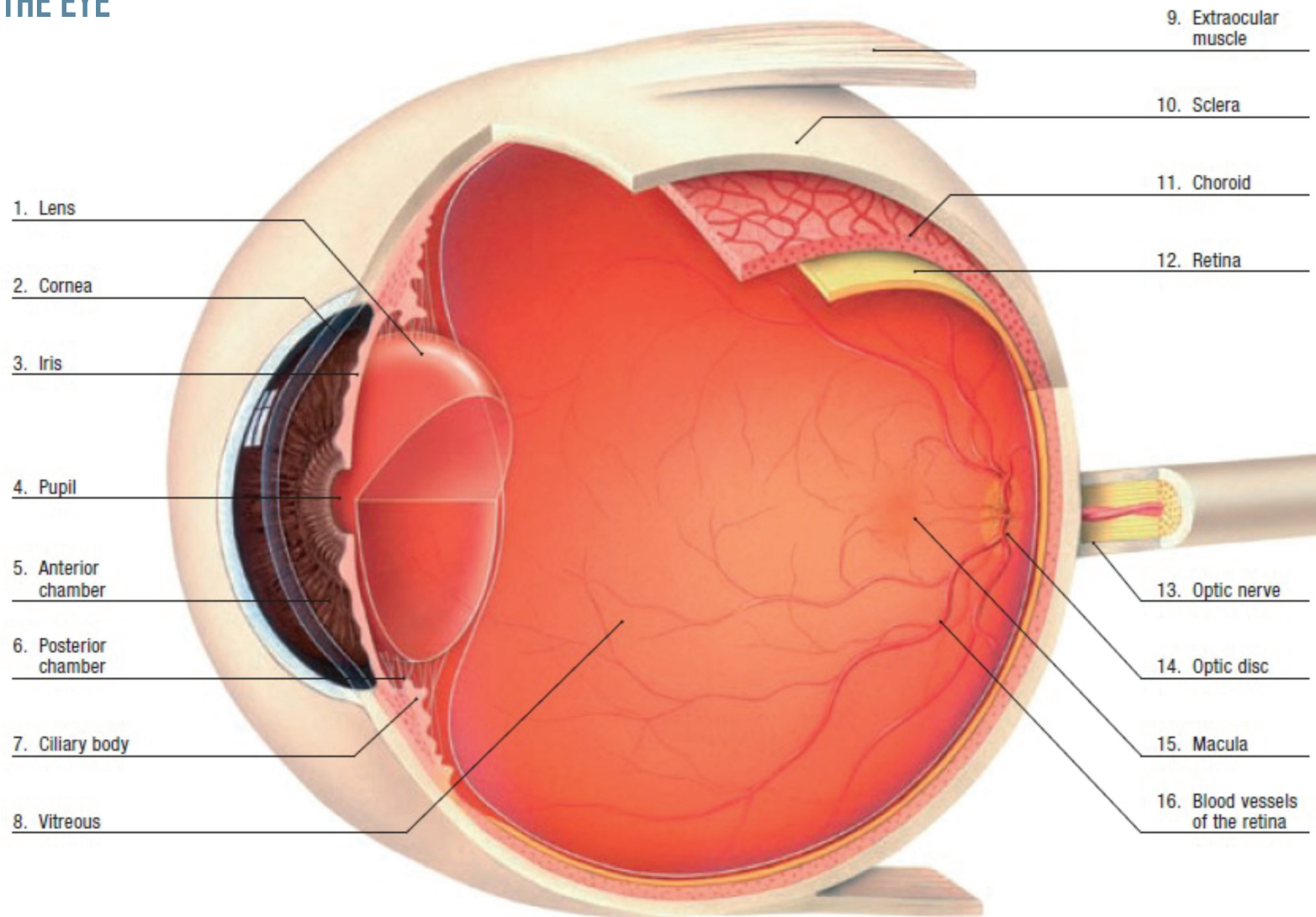
Joystick

Rheostat

Power switch



ANATOMY OF THE EYE



WHAT IS A SLIT LAMP?

The slit lamp is essentially a simple piece of equipment. It consists of an illumination system and a binocular observation system, which when correctly aligned will result in a coincidental focus of the slit and microscope.

Traditionally the Slit Lamp is a table top device, but for paediatric, a veterinary and other specialised requirement there is a portable hand-held device available.

THE ILLUMINATION SYSTEM

Basically a short focus projector projecting an image of the illuminated slit aperture on to the eye. This part of the system should be flexible to allow various sizes and shape of slit beam. Usually a rheostat is incorporated and the lamp house can be rotated. Neutral density, cobalt blue and red free filters are usually available, and occasionally a diffuser and polariser.

There are two different types of illumination system:

- a The Tower or Haag Streit type system where the light source is at the *top* of the device.



Generally this type is preferred in *ophthalmology*

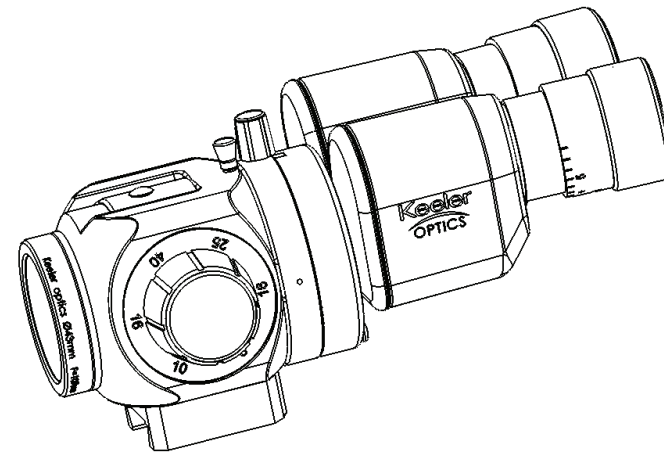
- b The Lower or Zeiss type system where the light source is at the *bottom* of the illumination system.



Generally this type is lower cost and often preferred in *optometry*.

THE OBSERVATION SYSTEM

Consists of a binocular microscope with parallel or convergent eyepieces (some practitioners may get diplopia with parallel eyepieces). Generally magnification from 6x to 40x is available using a drum change or flip lever magnification change system.



The illuminating system and observation system are normally focused at the same point - coupled. Although there are some occasions when it is better to focus the slit at a different point to where the observation system is set-de-coupled. See Sclerotic scatter below.

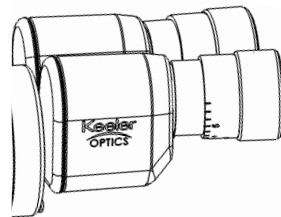
SETTING UP THE BINOCULARS; PD AND DIOPTRIC CORRECTION

Before commencing any work with the slit lamp it is important to ensure that your instrument is correctly set up:

It is vital that the binoculars are optimised for the user's optical correction in order to obtain focused binocular images.

- 1 Place the test bar focus in the test bar location hole at the base of the microscope arm. To access the location hole first remove the cover. The test bar should be set with the flat projection face towards the Slit Lamp Microscope. The illumination and the microscope should be in the zero degrees position.
- 2 Turn on the Slit Lamp, and set the slit to full width, set the magnification to x16
- 3 Adjust the eyepieces pupillary distance by holding both eyepiece bodies and rotating them inwards or outwards until they are correct for your PD
- 4 Turn both eyepieces to maximum plus (+) correction.

Close one eye, and with the other eye look through the microscope slowly turning the open eye eyepiece towards the minus (-) position until the image of the test bar is in focus. Stop.



- 5 Repeat the above process for the other eyepiece.
- 6 Make a note of the positions of the eyepieces so that you can set them quickly if the Slit Lamp has been used by another clinician.
- 7 Note – younger examiners are recommended to compensate for their ability to accommodate by further adjusting the eyepieces by minus one (-1) or minus two (-2) dioptries.

USING THE SLIT LAMP

When using the slit lamp it is important that you are aware of the various techniques you are employing and when to use them. As with any technique, a general routine should be established, in most cases when examining the eye and adnexia (surrounding area) a general rule of thumb might be to use a large field of view (low magnification) initially and then focus in on detail when required with larger amounts of magnification.

- 1 Commence the examination using the 10x magnification and the lowest illumination setting.
- 2 Select the longest slit length by means of the appropriate lever. Adjust the chin rest so that the patient's eyes are approximately level with the black marker on the side of the head rest.
- 3 Adjust the height of the slit lamp until the slit beam is centred vertically on the patient's eye.
- 4 Focus the slit beam on the eye by moving the joystick either towards or away from the patient. Coarse positioning can be effected without using the microscope but critical focussing should be carried out whilst viewing through the microscope.
- 5 The slit width is varied by rotating either the left hand or right hand slit width control.
- 6 To vary the angle between illumination and microscope use one or other of these same controls as handles to swing the illumination tower from side to side.
- 7 The slit should be set primarily in the vertical position, but any desired angle of rotation can be achieved by swinging the filter / slit rotation lever (notches at 45°, 90°, 135°; stops at 0° and 180°).
- 8 By tripping the inclination latch and tilting the slit lamp column, the beam can be introduced from as much as 20° below the horizontal. This is mainly used for carrying out gonioscopy (examination of the angle using a contact examination lens).
- 9 For observation by sclerotic scatter or other dissociated forms of examination the centring screw is loosened, so that the slit image can be moved away from the centre of the field of observation. The image is centred again by tightening the screw.

METHODS OF OBSERVATION AND USE

The slit lamp offers a variety of illuminating and observing methods which do not all have to be used in routine examination, but the ability to perform them should be practised. Not all slit lamps will allow all methods to be performed.

The following is a suggestion as to the way a routine technique should be performed. It is by no means the only way to perform a slit lamp routine and indeed not all practitioners will do so. A good routine is one that you feel comfortable with and that allows you to detect and investigate any irregularities and note the normal condition (base-line data) of the eye.

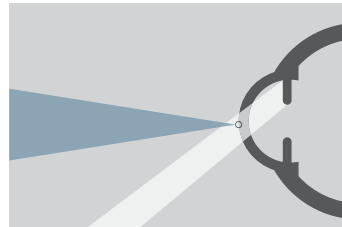
The examiner uses one hand to operate the joystick and the other to control the magnification, fixation light position and the type and angle of illumination, merging from one method to another until the examination is complete. The setting-up and use of each kind of illumination must be practised until the proceedings become automatic.



Regardless of the type of illumination used, to examine the entire cornea/sclera/lens you must ask the patient to look up, down, right, left (holding the upper or lower lid when necessary).

DIFFUSE ILLUMINATION

This is a good method of observing the eye and adnexa in general. Diffusers are sometimes supplied with slit lamp and can be 'flipped-over' the illuminating system or dialled in on the filter system. Diffusers are generally ground glass plates that cover the light source, if these are not available a piece of tissue might suffice to diffuse the light although this can sometimes be precarious as the tissue often falls off!



The slit should be fully open, diffuser in place and the angle between the illumination and the viewing axis should be between 30° and 50°. Magnification should be as low as possible to give a large field of view.

DIRECT/FOCAL ILLUMINATION

This is the most common method of viewing all tissues of the anterior eye, the focused slit is viewed directly by the observer through the microscope. The magnification can be increased quite markedly (10x to 40x or more) to view any areas of interest in greater detail.



The angle between the illumination and the viewing axis should be as large as possible, and the slit to a minimum, for example 0.1mm or 0.2mm

Any size or shape of beam can be used, and it is important to be aware of the main options available on your Slit Lamp.

METHODS OF OBSERVATION AND USE

BROAD BEAM (PARALLELEPIPED/SLIT)

Generally a very wide beam is used for surface study, whilst a very narrow one is used for sections. A useful combination of the two is the parallelepiped section of the cornea, which uses a 2mm slit width enabling corneal surface as well as stroma to be studied. This allows us to ascertain the depth of any interesting feature e.g. foreign body, corneal abrasion. Direct illumination on the front surface of the crystalline lens reveals the 'orange peel' effect (produced by the cell bodies of the lens fibres just below the front surface of the lens), and on the iris allows observation of iris pattern.

NARROW BEAM (OPTIC SECTION)

This technique is only used if you wish to investigate something. It should not be used to search for abnormalities. However, once an abnormality has been found it is easier to determine the precise depth using an optical section. The resolution of the section can be improved by reducing the slit width to a minimum, and be viewed more clearly by increasing the magnification. Generally the angle between the illuminating and observation systems should be set around 45 to 60 degrees, however to increase the amount of cross section, this angle can be further increased to 90 degrees. A good corneal section will allow at least 4 layers to be seen - tears (outer), epithelium (and Bowman's membrane), stroma seen as the central grey granular area and the fainter back line which is the endothelium (and Descemet's membrane).

When looking at the lens, variations in refractive index and transparency can be seen allowing observation of the Y sutures and any lens opacities. Opacities scatter and reflect more light and therefore appear white

against the grey background. Sometimes due to pigmentation, opacities may appear blue (congenital) or brown.

VAN HERICK'S TECHNIQUE

A further use of an optical section is to assess the degree of openness of the anterior chamber angle. The method is as follows:

Use a low magnification (6x or 10x) to give an adequate field of view. Set the beam 60 degrees to the side of the microscope and place a narrow slit as close to the limbus as possible and normal to the cornea. To assess anterior chamber depth you compare the width of the cornea seen by the optical section with the dark section seen between the front surface of the iris and the back of the cornea. The findings are classified into four grades:

GRADE 4 The ratio of aqueous to cornea is 1:1 - open angle

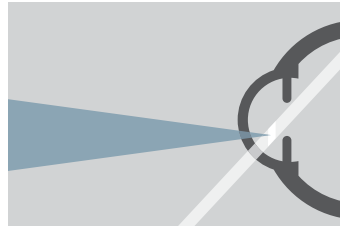
GRADE 3 The ratio of aqueous to cornea is 1:2 - open angle

GRADE 2 The ratio of aqueous to cornea is 1:4 - indicates narrow angle, which should be viewed by gonioscopy.

GRADE 1 The ratio is smaller than 1:4 - indicates dangerously narrow angle, which is likely to close.

CONICAL BEAM OR THE 1MM SQUARE

An important modification of direct illumination is used when inflammatory cells (proteins) within the anterior chamber are suspected (as in acute anterior uveitis). This will show up as aqueous flare, and can only be accurately seen using a conical beam of light, set at an angle of between 45 and 60 degrees and focused onto the front surface of the cornea. Using the pupil as a dark background, aqueous flare may be seen in the space between the focused beam of light on the cornea and the out of focus beam on the lens. In the normal eye this space will be perfectly clear. To use this technique the room illumination must be completely dark.



INDIRECT ILLUMINATION

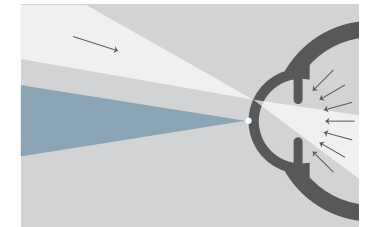
This simply means looking at tissue outside the area which is directly illuminated and can be used in conjunction with most of the above techniques. Structures are often easier to see under indirect illumination as glare is reduced e.g. opacities, corneal nerves and limbal vessels. When using the slit lamp direct and indirect illumination are viewed simultaneously, structures viewed in the illuminated field are seen under direct illumination, but as this does not fill the whole of the field of view, anything which reflects or scatters light from outside the illuminated area is being viewed by indirect. It is therefore important to look at the entire field of view and not just the illuminated patch.



If you wish to view a certain feature by indirect illumination first locate it by direct illumination and keeping your viewing system unchanged swing the lamp to one side. Occasionally it is necessary to de-couple the beam to enable you to move the beam to one side

RETRO-ILLUMINATION

This is another form of indirect viewing. The light is reflected off the deeper structures, such as the iris or retina, while the microscope is focused to study the more anterior structures in the reflected light. The most typical use is to study the cornea in light reflected from the iris, or the lens in light reflected from the retina. Features that are opaque to light appear dark against a light background (e.g. scars, pigment, and vessels containing blood). Features that scatter light appear lighter than the background (e.g. oedema of the epithelium, corneal precipitates). Note that this method is useful for examining the size and density of opacities, but not their location.



- 1) Use a parallelepiped focused (for example) on the iris.
- 2) For direct retro-illumination: the observed feature on the cornea is viewed in the direct pathway of reflected light. The angle between the microscope and the illuminating arm is about 60°.
- 3) For indirect retro-illumination: the angle between the microscope and slit-lamp arms is greatly reduced or increased so that the feature on the cornea is viewed against a dark background. It may be necessary to uncouple the beam.

METHODS OF OBSERVATION AND USE

SPECULAR REFLECTION

This type of viewing is achieved by positioning the beam of light and microscope such that the angle of incidence is equal to the angle of reflection. The light can be reflected from either the anterior (i.e. tears & epithelium) or posterior (i.e. endothelium) corneal surface. Note that the reflected light should pass through only one eyepiece, and therefore this method is monocular.

METHOD FOR VIEWING THE CORNEAL ANTERIOR SURFACE (THE EPITHELIUM)

- 1 The angle between the light and microscope arms should be about 45°
- 2 Use a magnification of about 25 times, and a moderate parallelepiped.
- 3 Gradually change the angle of the light source until a bright area of pre-corneal fluid is seen. Elevations and depressions of the anterior surface appear as dark spots in the brightly reflected area. Details of the pre-corneal film, mucous secretion, and corpuscular elements of tears may be seen.

METHOD FOR VIEWING THE CORNEAL POSTERIOR SURFACE (THE ENDOTHELIUM)

- 1 The angle between the light and microscope arms should be about 60°
- 2 A 2mm wide parallelepiped and magnification of 20-25x is used.
- 3 Find the image of the illuminating bulb, then move the light beam until the image of the bulb is just behind the posterior surface of the parallelepiped. Incidence = reflection when the dazzle from the pre-corneal fluid is seen.

- 4 Focus on the back of the parallelepiped. A mosaic of hexagonal endothelial cells will appear. The posterior endothelium and keratic precipitates may thus be studied.

USES

- 1 To examine the epithelium and endothelium. Note that the quality of the reflection formed gives an indication of the quality of the surface from which the light is reflected.
- 2 Examination of the tear film.
- 3 Examination the crystalline lens.

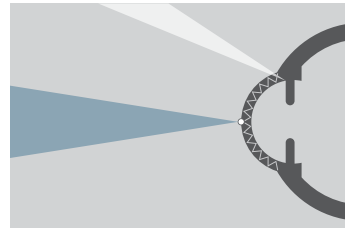


This technique is basically a method of evaluating the reflective qualities of the surfaces of the eye, and gives an indication of the surface quality. The four Purkinje image's are used as backgrounds - the first to view the tears / epithelium, the second to view the endothelium of the cornea, the third the anterior surface of the lens capsule and the fourth, the posterior surface of the lens capsule.

This method of illumination is particularly useful to examine the endothelium layer of the cornea (e.g. blebs, polymegathism), although very high magnification is necessary, at least 40x is required and to see individual cells 80x. As deeper layers are viewed with this method the angle between the two systems needs to be reduced (only 5 degrees between them is required when viewing the posterior lens capsule).

SCLEROTIC SCATTER

This method uses the principle of total internal reflection. A narrow vertical slit (1-1.5mm in width) is directed in line with the temporal (or nasal) limbus. A halo of light will be observed around the limbus as light is internally reflected within the cornea, but scattered by the sclera. Any corneal opacities, oedema or foreign bodies will be made visible by the scattering light, appearing as bright patches against the dark background of the iris and pupil. It is important that the room illumination is as dark as possible.



For this technique, the cornea is usually viewed by the observer's naked eye, from around the side of the microscope, however it is possible to observe the cornea using the microscope as well. To do this the slit must first be focused with direct/focal illumination (see below) on to the debris of the tear film. This ensures that the corneal surface is focused correctly. Then without moving the observation system or the entire slit lamp, the system is de-coupled and the illuminating system directed at the limbus. This will give sclerotic scatter and still allow the anterior surface to be viewed through the microscope, and allow the observer to use the most appropriate amount of magnification.

OSCILLATORY ILLUMINATION

A beam of light is rocked back and forth by moving the illuminating arm or rotating the prism or mirror. Occasional aqueous floaters are easier to observe. This technique can also be used to determine the extent of opacities in the crystalline lens.

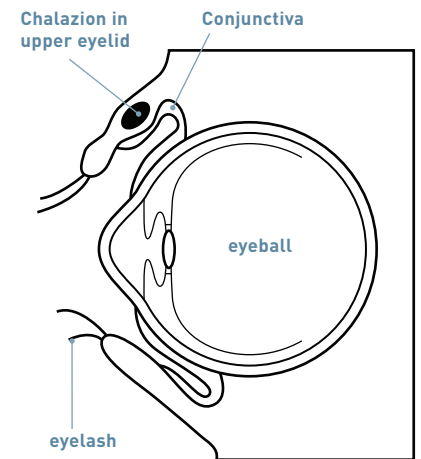
TANGENTIAL ILLUMINATION

The iris is examined under very oblique illumination while the microscope is aligned directly in front of the eye. Useful for examining tumours and naevi of the iris.


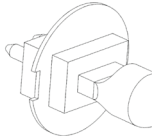



INDICATIONS FOR SLIT LAMP ROUTINE EXAMINATION IN PRIVATE PRACTICE

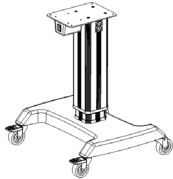
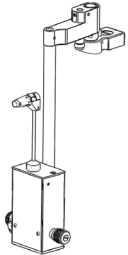
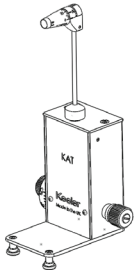
It certainly can be argued that slit lamp examination is the very best method of examining the external eye and should therefore be used with every patient. Here is a list of ocular conditions and complaints that could warrant slit lamp examination:

- 1 Conjunctival injection (Red eye)
- 2 Lacrimation (excess tears)
- 3 Itchiness
- 4 Grittiness
- 5 Pain
- 6 Dry eyes
- 7 Photophobia (light sensitivity)
- 8 Haloes around lights
- 9 Narrow anterior angle
- 10 Recent foreign body sensation
- 11 All contact lens wearers
- 12 History of anterior uveitis (aching and inflammation)
- 13 Ingrowing eyelashes
- 14 Pterygia (benign growth of the conjunctiva)
- 15 Blepharitis (inflammation of the eyelids)
- 16 Meibomium cysts (Cyst on the upper or lower eyelid)
- 17 Styes (hordeolum)
- 18 Unexplained reduced visual acuity
- 19 Lens opacities (best seen through dilated pupil)
- 20 Iris pigmentation
- 21 Irregular pupil margins
- 22 Increased IOP over 40mm Hg (possible corneal oedema)



ATTACHMENTS FOR THE SLIT LAMP

Part name	Part number	
Test bar	EP39-80243	
Bulb	1030-P-7160	
Small projection mirror	EP39-80250	
Long projection mirror (standard)	EP39-80052	
Joystick rubber	EP39-70369	

Part name	Part number	
Motorised Table leg, multi tension input	3020-P-7000	
Tonometer R type	2414-P-2040	
Tonometer T type	2414-P-2030	

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The logo for Keeler, featuring the word "Keeler" in a bold, blue, sans-serif font.