Essential contact lens practice

4 – Slit lamp examination

In the fourth article in our major bimonthly series about modern contact lens practice edited by **Dr Rachel Hiscox**, **Amanda Davidson** describes examination of the eye with the slit lamp (C72739, one distance learning CET point suitable for optometrists, contact lens opticians and dispensing opticians)

Careful slit lamp examination of the anterior eye is an essential part of contact lens practice. Guidelines from professional bodies, such as the College of Optometrists specify that contact lens practitioners must have a slit lamp microscope.[1] The guidance further specifies that the practitioner must carry out a detailed assessment of the anterior eye which might be affected by wearing contact lenses – for example, the cornea, conjunctiva, limbus, lids and tear film. This article will consider how the slit lamp examination should be performed during contact lens fitting in a systematic manner to ensure all relevant information is captured and used to inform contact lens selection.

ESSENTIAL CONTACT LENS PRACTICE

- Insights into contact lens wear
- Initial patient discussion
- Initial examination 1 – refraction and corneal assessment
- **Initial examination 2 – slit lamp**
- The tear film in contact lens wear
- Contact lens selection
- Soft contact lens fitting
- Soft toric contact lens fitting
- Managing the presbyope
- Rigid contact lens fitting
- Instruction and compliance
- The aftercare
- The future for contact lenses

TECHNIQUE AND SET UP

Correct set up of both the slit lamp and the patient is essential for accurate observations.

Instrument focusing

It is essential to focus the slit lamp prior to commencing examination as a slightly out of focus image at low magnification will become indistinguishable once the magnification is increased. The aim is for the microscope to be focused at the same plane as the illumination system, which typically has a fixed focus and cannot be altered. Accurate focusing can be achieved using the focusing rod placed in the pivot hole of the slit lamp, together with a high magnification and a medium width beam.

Eyepieces should be rotated fully anti-clockwise, producing maximum plus, before each eyepiece is focused individually by rotating the eyepiece clockwise, decreasing the plus, until the grainy appearance of the slit beam on the focusing rod is clear. Care should be taken not to rotate the eyepieces further than this point as this will induce accommodation in younger users. When both eyepieces have been focused their separation should be adjusted so as to allow a comfortable and clear binocular view of the focusing rod surface.

Patient position

Before you position your patient, do not forget to clean the slit lamp.

The College of Optometrist's Guidance for Professional Practice emphasises the importance of clear and effective communication with our patients[2] so it is important to explain to the patient the nature of the examination including what they should expect. It is also advisable to make sure that they are seated comfortably; the examination becomes significantly more difficult if the patient becomes uncomfortable and continually shifts position. Optimal position is achieved when the patient's head is central on the chin rest, with the outer canthus aligned with the guide on the head rest

SLIT LAMP ROUTINE

A slit lamp routine is something that a practitioner develops over time and can vary according to the patient and their presenting symptoms and history. While the exact order of the examination will vary between practitioners, typically the examination will start with low magnification and diffuse illumination for general observation, with the magnification increasing and more specific illumination techniques employed to view structures in greater detail. Throughout the routine different magnification and illumination techniques are used in order to carefully view different structures of the anterior segment (table 1). These techniques are

TABLE 1 Summary of structures and conditions viewed at each stage of the slit lamp examination

Illumination	Magnification	Filters	Slit Width	Structures Examined	Conditions Evaluated
Direct	Low	No	Wide/ diffuse	Lashes	Blepharitis
				Bulbar conjunctiva	Hyperaemia Pterygium Pinguecula
				Palpebral conjunctiva	Follicles Papillae Hyperaemia
	Medium/high	No	Wide	Lid margins	Meibomian glands Patency of tear ducts
		Blue, if using NaFl	Wide/ diffuse	Lid wiper area	Lid Wiper Epitheliopathy (LWE)
		No	Wide/ diffuse	Bulbar conjunctiva	Lid Parallel Conjunctival Folds (LIPCOF)
			Medium	Cornea	Opacities
				Iris	Naevus
		Red free		Limbus	Vascularisation
	High	No	Narrow	Cornea	Epithelial dystrophies Dellen Striae Folds Endothelial morphology
				Tear Film	Quality (eg debris)
	Medium/high	Blue	Medium	Cornea	Staining
				Conjunctiva	Staining
Indirect	Low	No	Medium	Cornea	Corneal Opacities Central corneal clouding
	High	No	Narrow	Limbus	Vascularisation

described in detail by various authors.[3-6]

With practice, practitioners will be able to utilise a combination of viewing techniques to systematically examine the anterior eye to detect abnormalities or issues which may affect contact lens fitting (table 2). A wider or diffuse beam with a low magnification will enable the practitioner a general overview at the same time as providing a greater depth of focus, while narrowing the beam and increasing magnification allows a more detailed observation but with significantly less depth of focus. By continually varying magnification, beam widths and observation techniques different structures can be assessed with accuracy and efficiency.

OVERALL VIEW – LOW MAGNIFICATION

It is best to begin most examinations with low magnification (6 to 10x) and a wide beam, preferably with diffuse illumination to allow for general observation of the ocular structures (figure 1).

Several sweeps across the adnexa should be performed, focusing attention sequentially on different anterior structures. Starting with the lids closed, the lid margins and lashes can be examined for signs of blepharitis or styes. Instructing the patient to open their eyes will allow the upper and lower lid margins to be examined for any signs of meibomian gland dysfunction and to assess the position of the puncta. Patency of the meibomian glands should not be assessed at this stage as expressing lipid into the tear film will affect later tear film evaluations. Assessment of blink patterns can be performed at this stage if this has not already been noted.

Once the lids have been observed, attention and focus should move to the bulbar conjunctiva to assess the level of hyperaemia and the possible presence of any irregularities of the conjunctival surface such as pinguecula or pterygium as these may potentially impact contact lens fit and comfort (figure 2).

TEAR FILM EXAMINATION – MEDIUM TO HIGH MAGNIFICATION

With higher magnification (16 to 24x) and a thinner beam (2 to 3mm) tear film quality and quantity can now be assessed. It is important to examine the tear film at this early stage in the slit lamp routine as prolonged exposure to bright light may induce reflex tearing, leading→

TABLE 2 Variations from normal that need to be considered in the initial slit lamp examination

Structure	Variation from the norm	Management options
Eyelashes	Blepharitis	Consider managing alongside fitting unless severe
	Stye	Usually self-limiting. Wait until resolved before fitting
Eyelid margin	Meibomian gland dysfunction	Consider managing alongside fitting unless severe
Palpebral conjunctiva	Hyperaemia	Ascertain cause prior to fitting
	Follicles and/or papillae	Ascertain cause and consider appropriate management. Consider contact lens material properties
Bulbar conjunctiva	Hyperaemia	Ascertain cause prior to fitting
	Pinguecula/pterygium	Try to ensure minimal mechanical stimulus on the area
Limbus	Vascularisation	Record for baseline, carefully consider desired contact lens material properties and monitor closely
Cornea	Staining	Ascertain cause prior to fitting
	Opacities	Ascertain cause and record for baseline

FIGURE 1 Overview of the ocular adnexa, lids and lashes using 6x magnification and diffuse illumination

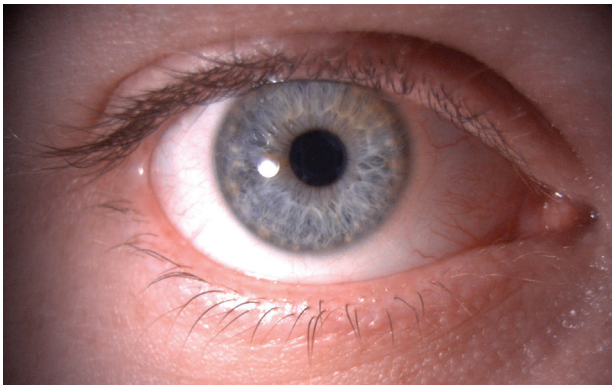


FIGURE 2 Grade 1 pinguecula slit lamp photograph, taken at 10x magnification with diffuse illumination

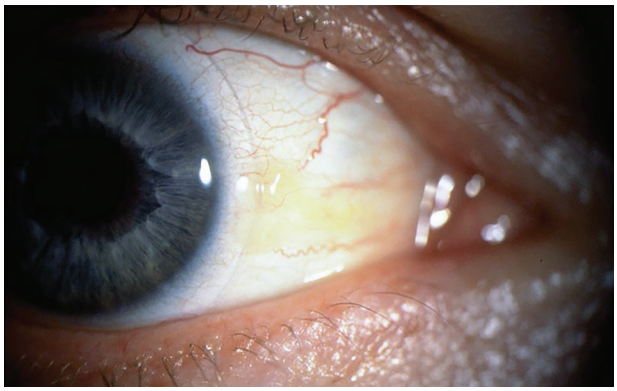


FIGURE 3 Observation of lipid layer coloured fringes (white arrow) using specular reflection

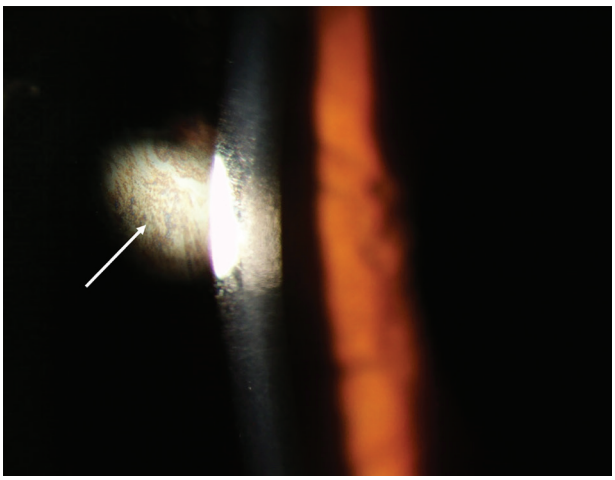
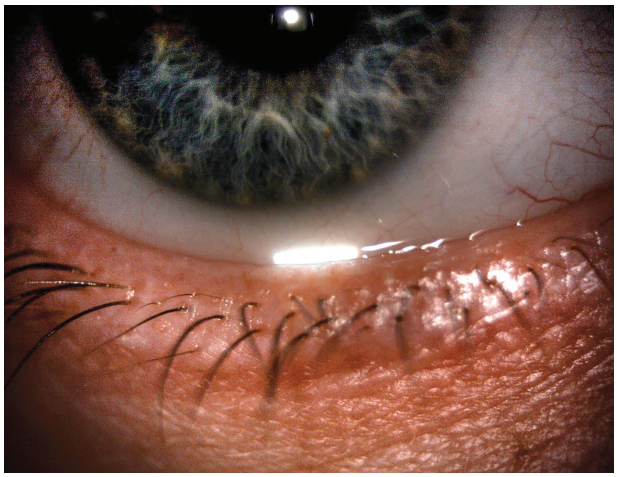


FIGURE 4 Measurement of tear meniscus height using the slit beam width, with the illumination rotated by 90 degrees



to inaccurate findings. Note should be made of the tear film quality with respect to any debris, eg makeup, presence of any frothing and thickness of the lipid layer by observation of the interference pattern[7] seen with specular reflection (figure 3). Tear volume can be measured using a horizontal slit beam and adjusting the slit width to match the tear meniscus height centrally along the lower lid (figure 4).

CORNEAL AND LIMBUS EXAMINATION – MEDIUM MAGNIFICATION

Continuing the examination, attention should now move to the cornea and limbus. Some practitioners like to use sclerotic scatter at this stage to check for any corneal opacities or localised corneal oedema. This technique involves decoupling the slit lamp and directing a slit beam of 1-2mm thickness on the temporal limbus

FIGURE 5 Observation of normal limbal vasculature using medium magnification

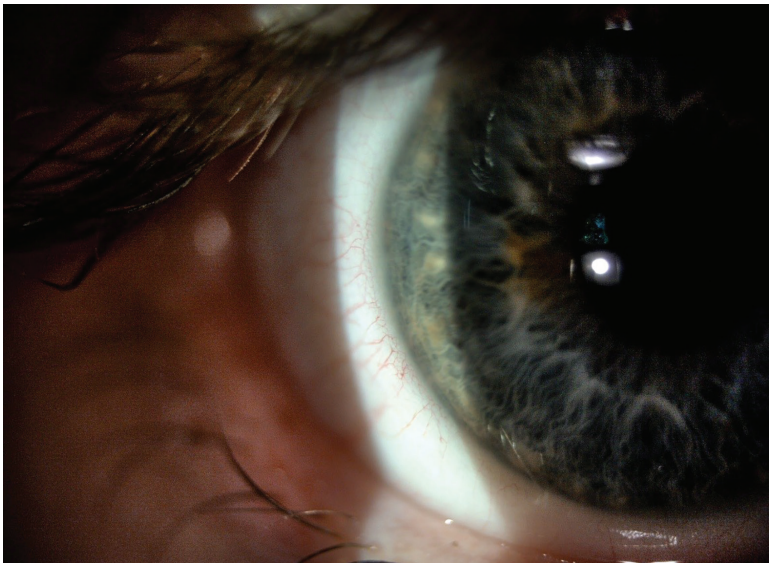


FIGURE 6 Optical section of the cornea, showing the epithelium, stroma and endothelium

at an angle of about 40 to 60 degrees in order to achieve total internal reflection within the cornea. Sclerotic scatter will result in a halo of light around the limbus and the objective is to detect any scatter within the cornea which should appear dark. To enhance the contrast of any light scatter, ambient room lighting should be minimised.

With the slit lamp re-coupled, a narrow beam (1 to 2mm) of medium brightness and approximately 10-16x magnification should be used to examine the cornea, beginning at the limbus and sweeping across the cornea to detect gross abnormalities. Physiological corneal vascularisation (blood vessels overlying clear cornea) should be differentiated from any neovascularisation (new vessels growing into clear cornea). Blood vessels are seen using both direct illumination (figure 5), looking directly at the illuminated area of the cornea, or indirectly, looking to the side of the illuminated cornea, simultaneously.

Retro-illumination may also be used whereby vascularisation is viewed by illumination resulting from diffuse scatter coming off the iris and illuminating the vessels from behind. A red-free (green) filter can aid observation of vascularisation. During observation of the limbal region, the presence or absence of peripheral infiltrates should be noted.

CORNEAL EXAMINATION – HIGH MAGNIFICATION

After gaining a gross overview of the cornea, the slit width should be reduced to its minimum to allow observation of the cornea in →

FIGURE 7 High magnification of the cornea showing simultaneous observation of striae in the optical section under direct illumination and a microcyst by direct, retro-illumination

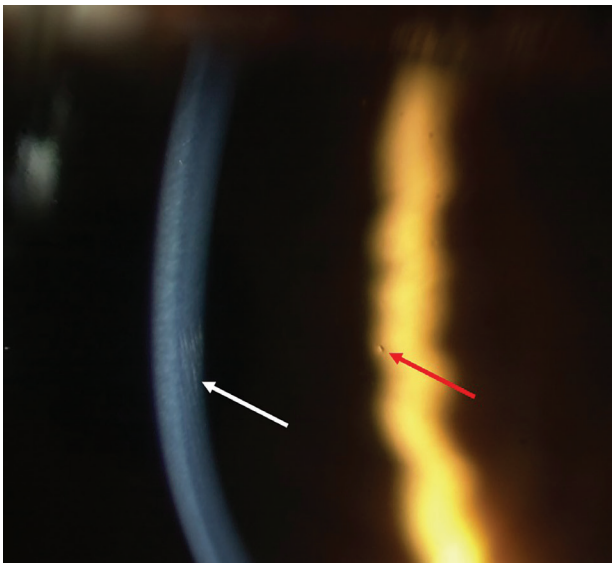


FIGURE 8 Observation of the endothelium with specular reflection using high magnification. Endothelial cells are seen to the right of the bright reflection, as indicated by the white arrow

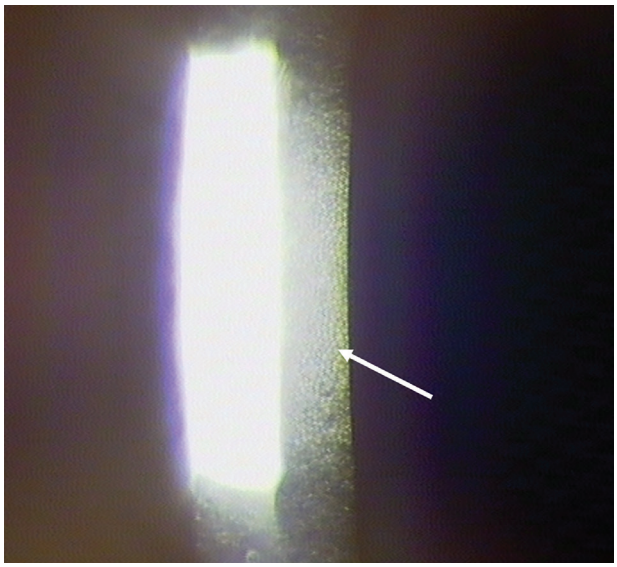


FIGURE 9 Foreign body stain showing light fluorescence, indicating damage has not breached the epithelium

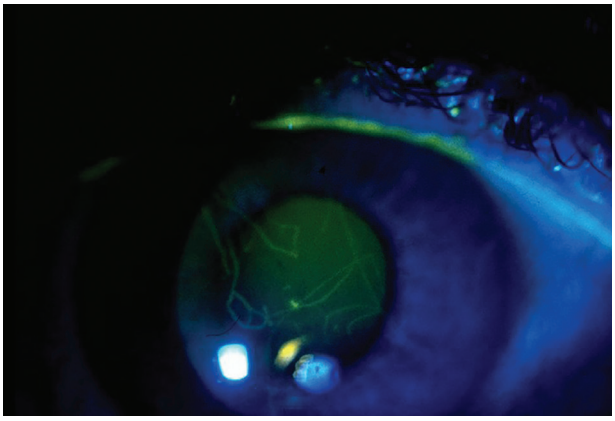
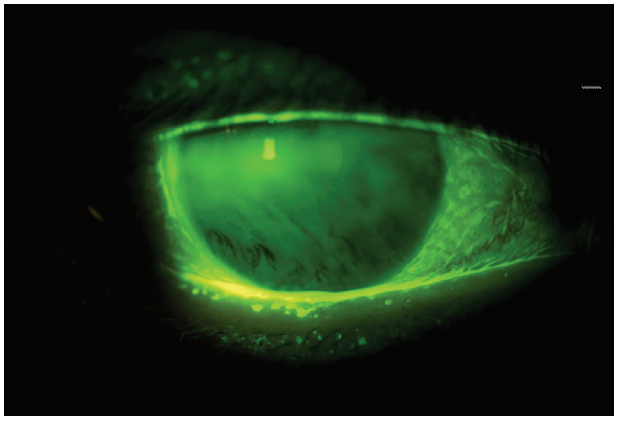


FIGURE 10 Examination of tear film break up using fluorescein. Break up is seen as the black 'streaks' inferiorly



cross section (figure 6). The clarity of the section is determined predominantly by the width of the slit; the thinner the slit the better the quality of the section. With high magnification and illumination, systematically sweep the cornea, taking care not to miss any part. Any opacification should be recorded, with the cross-sectional view allowing the depth to be determined. Though highly unlikely to be seen, especially in a contact lens neophyte, epithelial microcysts, a sign associated with corneal oedema typically secondary to hypoxia, can be observed at this stage by viewing the cornea with direct retro-illumination (figure 7).

The final part of the corneal examination is to observe the endothelium using specular reflection. The endothelium will be visible monocularly as a dull patch to the side of the slit beam (figure 8).[8] With a good slit lamp that has high resolution and magnification it is possible to view individual cells, however, in some cases it is only possible to make a gross clinical judgement. Should more detail be required, a specular microscope needs to be employed. Endothelial polymegathism describes a significant variation of apparent cell sizes; the extent of polymegathism increases throughout life, however, it is important to note any excessive changes outside of expected age-related changes which may be caused by chronic hyopoxia.[9] Fortunately, endothelial changes are very rarely seen with modern contact lens materials.

STAINS

The most commonly used stain in optometric practice, and critical during contact lens fitting and aftercare is sodium fluorescein. Sodium fluorescein is often referred to as a vital stain but is actually a fluorescent pH indicator that will fluoresce more in an alkali environment. As the deeper layers of the cornea are more alkali, any breach of the epithelium will cause fluorescence or 'staining', with the intensity of fluorescence increasing with depth. The appearance of the green fluorescein may be enhanced by filtering out the blue excitation light by placing a yellow barrier filter over the observation system.

Corneal fluorescein staining should be observed using medium magnification, a narrow beam and high illumination, systematically sweeping across the cornea to detect small area of staining with gaze directed up, down and straight ahead (figure 9). The conjunctiva should also be assessed in this way, with any staining noted accurately graded and recorded.

FIGURE 11 The Meibomian Gland Evaluator (a) used to provide a standardised and repeatable evaluation of meibomian gland function by applying the pressure of a deliberate blink (b)

As well as being useful for examination of corneal and conjunctival integrity, fluorescein can also be used to evaluate the tear film stability and puncta patency. Following instillation, the time taken in seconds after a blink for areas of tear thinning and interruption of fluorescence should be recorded (figure 10). After instillation, sodium fluorescein will usually drain away after a few minutes. This may take a little longer with older patients due to narrowing puncta. It is useful to note if the sodium fluorescein takes longer to clear as it may indicate a blockage in the drainage mechanism.

INVASIVE EXAMINATION OF THE LIDS

With the tear film evaluations complete, the patency of the meibomian glands can also be evaluated by applying gentle pressure to the lid margin to observe and grade any secretions. This is best observed using a diffuse beam with low to medium magnification and using a Meibomian Gland Evaluator (figure 11) to apply standardised pressure to the lid margin.

Using low magnification and a wider beam, lid eversion should now be performed to assess the inferior and superior palpebral conjunctiva for hyperaemia and papillae (figure 12). Any residual fluorescein will pool around the boundary of papillae that might help their visualisation.

RECORDING RESULTS

The accurate and detailed recording of examination findings should not be underestimated; time should be taken to carefully record and quantify what is seen. Where possible grading scales should be used (figure 13). Table 3 lists structures that can be objectively measured or subjectively graded. Grading schemes may be quantitative, eg corneal staining (table 4) or banded according to clinical judgement (table 5). There are several different grading scales available to practitioners which have been validated for clinical use. While each grading scale has its advantages and disadvantages, it is important the practitioner – and indeed a practice – sticks to (and notes) the use of one system. →

FIGURE 12 Examination of the super palpebral conjunctiva using fluorescein to enhance visualisation of papillae

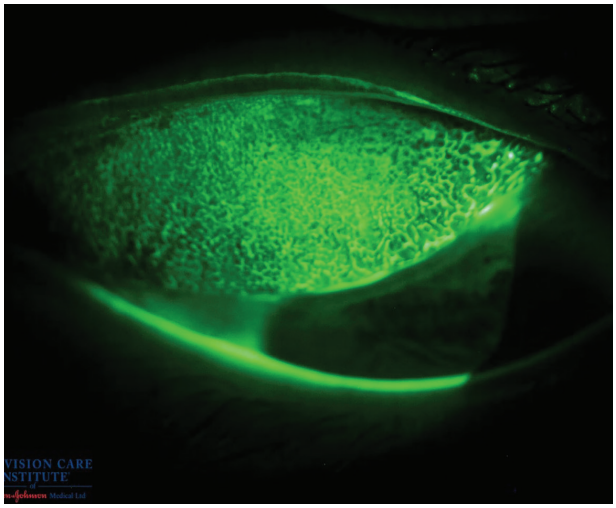
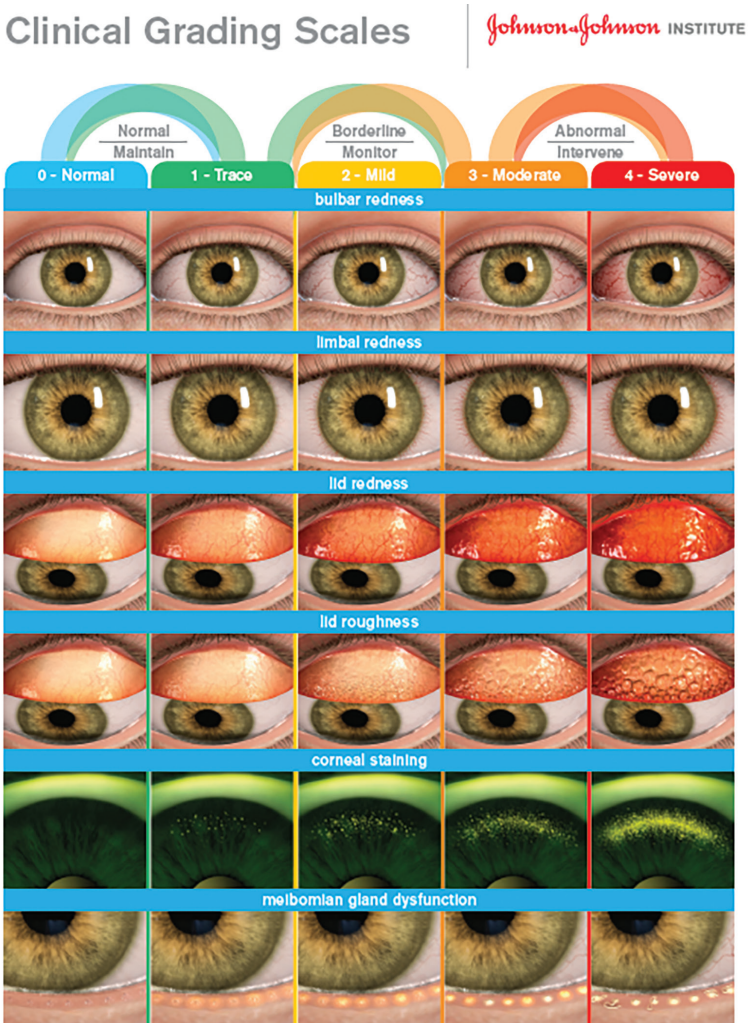


TABLE 3 Structures and lesions requiring measurement or grading

Objective measurement	Subjective grading
Vascularisation (size & position)	Staining
Folds (number)	Follicles
Striae (number)	Papillae
Pingueculae/pterygium (size)	Hyperaemia
Opacities (size & position)	Tear film quality
Infiltrates (size & position)	Blepharitis
Tear meniscus height	Meibomian gland dysfunction
	LIPCOF
	LWE

FIGURE 13 Example grading scale which can be used to record and monitor abnormalities



KEY POINTS

- Always remember to focus the slit lamp carefully before use
- Establish a systematic routine to ensure thorough examination of all ocular structures
- Using fluorescein is essential to examine ocular surface integrity. The use of an additional barrier filter will enhance observations
- Evaluate the tear film early in the examination, with the least invasive techniques performed first so as to provide the least disruption to the tear film's stability
- Grading scales are valuable in producing accurate and comprehensive records
- Careful examination of the anterior segment and tear film will aid in appropriate contact lens material selection

TABLE 4 The CCLRU grading for corneal staining[10]

Type	Depth	Extent of surface involvement
0 - Absent	0 - Absent	0 - Absent
1 - Micropunctate	1 - Superficial epithelial involvement	1 - 1% to 15%
2 - Macropunctate	2 - Stromal glow present within 30 secs	2 - 16% to 30%
3 - Coalescent macropunctate	3 - Immediate localised stromal glow	3 - 31% to 45%
4 - Patch	4 - Immediate diffuse stromal glow	4 - 46% or greater endothelium

TABLE 5 US FDA clinical grading

Type	Depth
0	Normal
1	Slight or mild changes from normal that are clinically insignificant
2	Moderate changes that may require clinical intervention
3	Severe changes that usually require clinical intervention
4	Very severe changes that require intervention, often medical

SUMMARY

The slit lamp examination is probably the most important aspect of contact lens practice. It is vital for assessing the potential for contact lens wear and for monitoring the established wearer. The examination must be comprehensive and objectively recorded so that when considered with the patient's history and symptoms, refraction and any other initial examinations the practitioner can give their patients the best advice and ultimately determine the best lens for the patient's individual needs thereby fulfilling the GOC Standards of Practice.[11]

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