Anterior Eye Health Recording

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Abstract

Aims: To survey eye care practitioners from around the world regarding their current practice for anterior eye health recording to inform guidelines on best practice.
Methods: The on-line survey examined the reported use of: word descriptions, sketching, grading scales or photographs; paper or computerised record cards and whether these were guided by proforma headings; grading scale choice, signs graded, level of precision, regional grading; and how much time eye care practitioners spent on average on anterior eye health recording.
Results: Eight hundred and nine eye care practitioners from across the world completed the survey. Word description ($p<0.001$), sketches ($p=0.002$) and grading scales ($p<0.001$) were used more for recording the anterior eye health of contact lens patients than other patients, but photography was used similarly ($p = 0.132$). Of the respondents, 84.5% used a grading scale, 13.5% using two, with the original Efron (51.6%) and CCLRU/Brien-Holden-Vision-Institute (48.5%) being the most popular. The median features graded was 11 (range 1 to 23), frequency from 91.6% (bulbar hyperaemia) to 19.6% (endothelial blebs), with most practitioners grading to the nearest unit (47.4%) and just 14.7% to one decimal place. The average time taken to report anterior eye health was reported to be 6.8±5.7 minutes, with the maximum time available 14.0±11 minutes.
Conclusions: Developed practice and research evidence allows best practice guidelines for anterior eye health recording to be recommended.

Keywords: anterior eye health; record keeping; contact lenses; best practice; grading; sketching; photography

Introduction

Accurate and repeatable recording of anterior eye health is essential in both clinical and research practice, to differentiate normal physiological variation from pathological changes, to monitor disease and is of particular importance where successive appointments could be conducted by more than one clinician. As there is often a focus on clinical records in legal cases, standardised and comprehensive record keeping has additional importance. In order to standardize anterior eye health recording between clinicians and to speed the process, subjective grading scales were popularized in the 1990s to replace aspects of wordy descriptions and sketches. Written descriptions of the same condition can vary widely.[1] Sketching can be useful in visually indicating proportions and locations, but eye care practitioners differ in their artistic ability and prowess. However, it could still be considered the best method to represent anterior eye staining if photography is not available, as it is difficult otherwise to capture multiple locations, shapes and sizes of features such as staining,[2] although depth description may need noting with wordings. However, only about one third of optometrists used sketching and just 2% indicated they would photograph in a recent study.[1]

Grading scales allow the anterior ocular appearance to be referenced to standard 'anchor' images chosen to cover the range of clinical presentations of a particular feature or tissue of the anterior eye. These can be drawn, such as the Efron and VisionCare Institute (Johnson and Johnson) scales, photographs such as the Brien Holden Vision Institute scales, or drawn features over healthy eye photographs such as the Jenvis (Alcon) scale. The use of these fixed scales aimed to increase reliability and reproducibility repeatability of clinical observations records among

clinicians. The scales usually contain between 4 and 5 images, with clinicians encouraged to interpolate to 1 decimal place to increase improve sensitivity.[3] Grading scale grades are not interchangeable,[4,5] with scales starting at grade 0 or 1 and with a wide range of highest grade. Hence practitioners should record the grading scale used (although this is rarely done)[1] and ideally standardise this within an individual practice or corporate groups.

While the grade has been linked to clinical interpretation of normality and the need of action, this overlooks physiological variation across the population and that management strategies relating to different features are required at different levels within the spectrum of 'severity' and varies between practitioners. For example the level of severity at which Australian optometrist would instigate treatment for corneal staining varied considerably between 'any sign of corneal staining' to 'grade 4 staining'.[1]

Subjective grading has been extensively used to quantify and monitor ocular features such as bulbar hyperemia, palpebral roughness and corneal staining with sodium fluorescein (Efron, 1998; Terry et al., 1995; MacKinven et al., 2001; Pritchard et al., 2003),[6-9] although the range of possible features to grade is vast and there is no widely accepted guidance on which features should always be graded and which should be added when marked pathology is noted. Despite best efforts however, the sensitivity and reliability of the resulting assessments has been shown to be limited,[10,11] with natural bias such as to whole numbers. Longer time dedicated to grading generally reduced the variation between individuals, but a couple of seconds was sufficient for most pathological features.[12] Even the linearity of grading scales

has been shown to be quite variable.[13] Research studies often grade the same feature in multiple regions of a tissue to improve sensitivity, but this is time consuming and still subjective.

To improve on subjective grading, several studies have investigated computer-based objective grading of ocular surfaces. With the rapid development of smart phone camera technology, with the addition of a macro-lens or slit lamp eye-piece adaptor, reasonable quality images of the anterior eye can be captured even if a practitioner does not have access to a digital slit lamp biomicroscope. The resolution of the image sensor does not have to be high to detect even the smallest features of interest in the anterior eye and moderate levels of image compression can be applied to reduce the file size with no ill-effects.[14] A camera with low light sensitivity is needed to image without uncomfortable levels of light for the patient and when imaging fluorescein fluorescence.[15] The though process involved in subjective grading, even of features such as bulbar hyperaemia, are complex with some debate over whether colour information is actually important in grading hyperaemia, or whether the perceived area of blood vessel coverage alone is sufficient.[10,16,17] However, image analysis techniques can predict the average experienced clinician grade,[2] but are many times more sensitive and reliable than subjective grading.[18]

As the current practice for anterior eye health recording is not known, this study builds on previous studies to improve the evaluation and recording of soft and gas permeable contact lens fit[19,20] by surveying eye care practitioners from around the world in order to inform guidelines on best practice.

Method

A web based survey was developed by the British Universities Committee of Contact Lens Educators (BUCCLE) which comprises of all the academic based contact lens educators in the UK and Ireland. BUCCLE is sponsored by industry and consists of two educators from each UK and Ireland institution which teaches contact lenses. The group meets three times per year with the aim of enhancing the teaching of contact lens education.[21] Brain storming and current UK teaching curriculum refined the survey to assess the following areas:

- Whether eye care practitioners used word descriptions, sketching, grading scales or photographs or a combination of these to record anterior eye health currently with contact lens and other patients
- Whether record cards were:
    - Paper-based or computerised
    - blank or proforma, and if the latter, did the headings include:
        - cornea
        - conjunctiva
        - lids and lashes
        - sclera
        - iris
        - media
        - lens
        - adnexia
        - other . . .
- Whether eye care practitioners used a grading scale, and if so:
    - Which one

    - Which signs did they grade (Table 1)
    - What level of precision did they grade to
    - Were multiple regions graded for the same feature
- How much time they spent on / was available overall for anterior eye health recording

Data on respondent's profession, principal working environment, number of years qualified and geographic location were also collected. The on-line survey was circulated through the British Contact Lens Association to eye care practitioners attending the 2013 annual conference, International Association of Contact Lens Educators and to education meeting attendees across the world (Irish Contact Lens Society 2013, Contact Lens Society of India Optic Advance 2013 Conference, 2nd Optometric Conference of Central & South Eastern Europe, Optrafair 2014 London, BOOTS Optician CET events 2014, European Academy of Optometry & Optics Conference Warsaw 2014 and South African Eye Advisors conference).

Table 1: Frequency and number of respondents who use grading scales, for different anterior eye features. N=680

Anterior Eye Feature Graded	Frequency	Respondents
bulbar/conjunctival redness/hyperaemia	91.6%	623
corneal staining - type	78.5%	534
limbal redness/hyperaemia	77.8%	529
corneal/stromal neovascularisation	69.4%	472
lid roughness or papillary conjunctivitis	69.0%	469
corneal staining - extent	67.2%	457
lid/palbebral/tarsal redness hyperaemia	63.4%	431
meibomian gland dysfunction	63.4%	431
conjunctival staining	62.2%	423
blepharitis	60.7%	413
corneal infiltrates	55.0%	374
corneal ulcer	52.4%	356
corneal oedema	49.1%	334
corneal staining - depth	48.7%	331
solution induced corneal staining	40.6%	276
corneal/stromal oedema	39.4%	268
epithelial microcysts	34.1%	232
superior limbic keratoconjunctivitis	30.7%	209
corneal distortion	28.7%	195
lid wiper epitheliopathy/upper lid margin staining	26.2%	178
lid parallel conjunctival folds	22.2%	151
endothelial polymegathism	19.6%	133
endothelial blebs	19.6%	133

Results

Eight hundred and nine eye care practitioners completed the survey. In total, 85.7% were optometrists, 10.6% contact lens opticians and 3.1% ophthalmologists. Their principal working environment was clinical practice for 75.4%, academic for 14.3% and the ophthalmic industry for 2.9%. Length of time in practice was ≤5years for 17.3%, 6-10 years for 16.9%, 11-20 years for 27.1%, 21-30 years for 28.4% and ≥31 years in 10.3%. Respondents were predominantly from the UK and Ireland (40.4%), and mainland Europe (37.0%), with 14.2% from Africa (predominantly South Africa), 3.6% from Asia and 3.0% from the USA and Canada. Hence there were sufficient cohort sizes to allow analysis of the differences between eye care practitioners in the UK and Ireland, mainland Europe and Africa who had a similar age profile (Kruskal-Wallis analysis of Variance on ranks; $F = 2.359$; $p=0.307$).

Current recording methods for anterior eye health for both contact lens wearers and other patients are presented in figure 1. Word description (Mann-Whitney Rank Sum Test $p < 0.001$), sketches ($p = 0.002$) and grading scales ($p < 0.001$) were used more for recording the anterior eye health of contact lens patients than other patients, but photography was used similarly ($p = 0.132$). Those from the mainland Europe used word description and sketching less than those from the UK and Ireland and Africa (Kruskal-Wallis analysis of Variance on ranks; $F > 25.000$; $p<0.001$), but used photography more ($F = 83.604$; $p<0.001$). Grading scales were used more by UK and Ireland eye can practitioners than those in mainland Europe ($F = 53.585$; $p<0.001$) who in turn used them more than those from African ($p<0.001$).

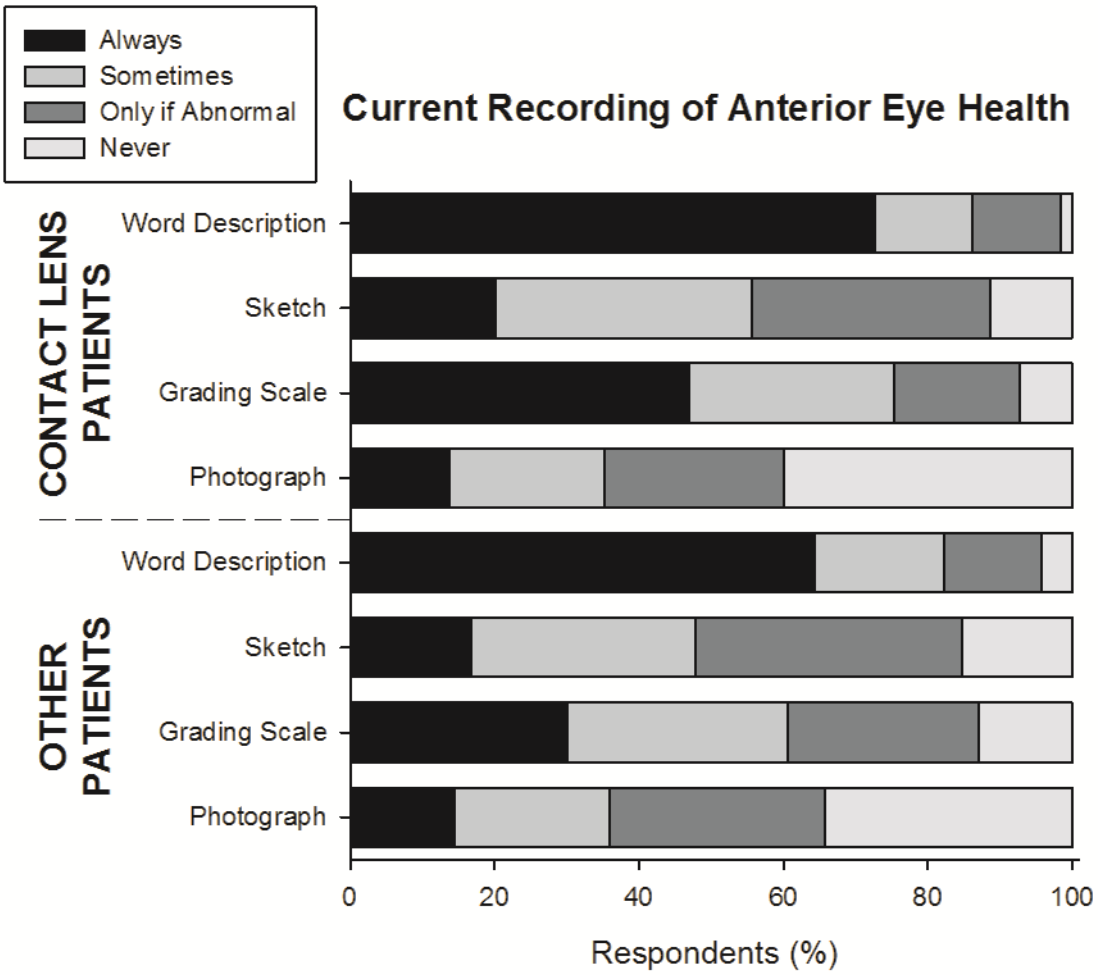

Figure 1: Current recording methods for anterior eye health for both contact lens wearers and other patients. N=809.

Paper record cards (85.9%, n=695) were used more often than electronic (31.5%, n=255), with 17.4% (n=141) using both paper and computer recording of patient information. Those from the mainland Europe used electronic record cards more than those from the UK and Ireland (Kruskal-Wallis analysis of Variance on ranks; $F = 63.448$; $p<0.001$) who in turn used electronic record cards more than those in Africa ($p<0.001$). Blank (56.4%, n=456) record cards were as frequently used as those with a proforma guide (61.1%, n=494) across the paper and electronic record

cards. For those that used a proforma, the features to record under included cornea (99.6%, n=492), conjunctiva (93.9%, n=464), lids and lashes (83.2%, n=411), lens (69.6%, n=344), media (60.7%, n=300), sclera (53.4%, n=264), iris (43.9%, n=217) and adnexia (44.5%, n=220). Other features mentioned in the comments relating to the anterior eye health section of the record card included tear film (n=42), anterior chamber (n=40), limbus (n=13), corneal sub-layers (n=4), vascularisation (n=3), staining (n=3), lid margin including glands (n=3) and subtarsal conjunctiva (n=1).

Of the respondents, 84.5% (n=680) used a grading scale with 13.5% (n=109) using two and 20 respondents reported using more than two different grading scales. Of those that used grading scales, the Efron (51.6%, n=351) and CCLRU/Brien Holden Vision Institute (48.5%, n=330) were the most popular grading scales, with the more recent Vision Care Institute (Johnson and Johnson) scale (16.5%, n=112) and Jenis (Alcon) scales (4.4%, n=30) less frequently used. The Efron scale was more commonly used in Africa (72.4%) and the CCLRU/Brien Holden Vision Institute least (14.9%) with less of a difference in mainland Europe (45.4% vs 33.5%), whereas the reverse was found in the UK and Ireland (31.3% vs 54.0%).

The number of features of the anterior eye graded had a median of 11 and range of 1 to 23 features (Table 1). The data were not normally distributed (K-S distance = 0.0719, $p < 0.001$) and were skewed to the upper end (skewness = 0.243; Kurtosis = -0.708; Figure 2). African eye care practitioners graded significantly less features (9.9 ± 5.2) than those in the UK and Ireland (12.1 ± 5.6) or mainland Europe (11.9 ± 5.7; Kruskal-Wallis analysis of Variance on ranks; $F = 10.149$; $p<0.001$). One

additional comment identified corneal indentation as an additional feature to be graded. Most respondents graded to the nearest integer unit (47.4%, n=322), with 37.9% (n=258) grading to the nearest half unit and 14.7% (n=100) grading to one decimal place. Those practitioners from Africa were less likely (Kruskal-Wallis analysis of Variance on ranks; $F = 50.895$; $p<0.001$) to grade to sub-integer resolution than those in the UK and Ireland ($p<0.001$) who in turn were less likely to grade to sub-integer resolution than those in mainland Europe ($p<0.001$). Almost one-fifth (19.6%, n=133) reported always grading multiple regions of the same feature (such as bulbar redness for nasal, temporally, superior and inferior regions), 32.0% 'sometimes' (n=217), 43.2% (n=294) 'only if something abnormal was noted' and 5.3% (n=36) 'never'. Those practitioners from mainland Europe were less likely to grade to sub-integer resolution than those in the UK and Ireland or Africa (Kruskal-Wallis analysis of Variance on ranks; $F = 12.954$; $p<0.001$).

The average time taken to report anterior eye health was reported to be 6.8 ± 5.7 minutes (range 1 to 45 minutes) with the maximum time available 14.0 ± 11 minutes, range 1 to 60 minutes. This was greater for eye care practitioners in mainland Europe than those in Africa (Kruskal-Wallis analysis of Variance on ranks; $F = 54.807$; $p<0.001$), who in turn were able to dedicate more time than those in the UK and Ireland (average time: 8.7 ± 6.3 minutes vs 6.4 ± 4.9 minutes vs 5.5 ± 5.2 minutes).

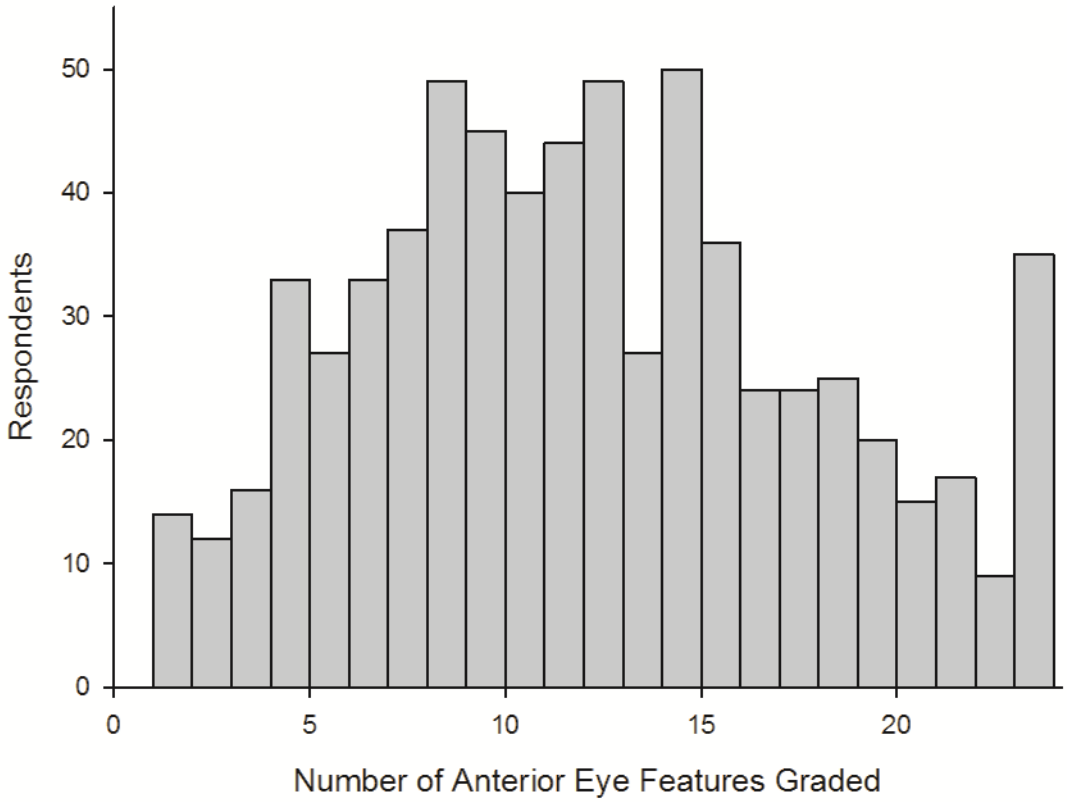

Figure 2: Number of anterior eye features graded by those who use a grading scale. N=680.

Discussion

In this large international sample of primary and secondary eye care practitioners with a relatively even spread in the number of years qualified, anterior eye grading was recorded principally by using word description, although grading scales and sketching was utilised more often for contact lens patients. Photography was less often used, despite the increasing popularity of smart phones which can capture high quality images of the anterior eye with an inexpensive macro lens and increasing availability of photo slit-lamps. These figures are slightly higher than those reported in a recent exercise to describe corneal staining in a photograph.[1] Photography allows automated objective grading which has been shown to be more sensitive and reliable than subjective grading.[2,18] Grading is faster and more accurate than word descriptions and sketching can better capture more complex features such as staining which differ in location, size, shape, intensity and depth. Hence practice could be enhanced by adopting this approach.

Paper record cards (which take up more space and are harder to search) are still preferred to electronic records (which can be less versatile for recording information in the form desired by the eye care practitioner), but intriguingly, one-sixth are using both. This is most likely to be explained by practitioners working at multiple practices. Record cards which were blank or contained anterior health proforma headings were equally popular.

Five-sixths of eye care practitioners gave information on the grading scales they used, which was similar to the proportion (7%) who report never using a grading scale for contact lens patients and for other patients (13%) in the first question. The percentage of practitioners using two or more scales was lower than that reporting using both paper and electronic record cards, so working in different practices could account for this difference, although grading scales portray varying features, so practitioners may be supplementing their normal grading scale. However, using more than one scale is likely to reduce consistency, which would impair patient follow-up as grading scale grades are not interchangeable.[4,5] Pictorial (Efron) and photographic (CCLRU/Brien Holden Vision Institute) were equally popular and having been around for about two decades[6,7] were used more than the more recent Vision Care Institute (Johnson and Johnson) and Jenis (Alcon) scales.

The number of features of the anterior eye graded was relatively diverse for many eye care practitioners, but how frequently they were used was not elicited. Baseline data is important to differentiating pathology as the physiological normal varies substantially between individuals. Bulbar, limbal and palpebral hyperaemia, neovascularisation, lid roughness, meibomian gland dysfunction and staining (both corneal and conjunctival) appear to be the key features to grade. It is interesting that staining type was graded by nearly 30% more of respondents than staining depth, although perhaps this key aspect was described in words rather than graded. Due to the complexity of staining (which differs in location, size, shape, intensity and depth) the authors recommend sketching (or photographing) for faster and more precise capture of information, although depth may still need to be described. Other features such as blepharitis, corneal infiltrates, corneal ulcer, corneal/stromal oedema, solution induced corneal staining, epithelial microcysts, superior limbic

keratoconjunctivitis, corneal distortion, endothelial polymegathism and endothelial blebs, should not occur in healthy eyes so can be recorded only when they are present unless their absence is part of a differential diagnosis initiated by the history and symptoms. Epitheliopathy/upper lid margin staining and lid parallel conjunctival folds are more recently highlighted physiological features of the eye whose link to dry eye or contact lens discomfort might promote them as additional baseline measures in the future.[22]

Despite the evidence as to the limitations of grading only to the nearest grading scale unit,[3,23] only one in seven of the practitioners surveyed have adopted grading to one decimal place. While clinicians may not feel confident in the accuracy of their grade to one decimal place, a slight difference in option between two practitioners will result in a smaller discrepancy than if they fell either side of the boundary between units grading to the nearest unit. Surprisingly, about one fifth of practitioners always graded multiple different regions of the same feature and a further third reported doing this ‘sometimes’, even when the feature was not considered abnormal (as this was a separate category), despite the time required to achieve this. From the range of time reported to be available to record anterior eye health by the respondents, it is clear that time pressure varies greatly, although anterior eye health is taken seriously enough to devote on average about double the amount of time if needed in specific cases. Longer time dedicated to grading generally reduces the variation between practitioners, but a couple of seconds has been found to be sufficient for most pathological features,[12] allowing anterior eye recording to be completed in a matter of minutes, particular with focused and prudent use of grading scales, sketching and photography.

Recommendations

Record which grading scale you use[1] and always grade to one decimal place to enhance sensitivity.[3,23]

Record what you see live (rather than trying to memorise the grading scale images) rather than based on how you intend to manage a condition.

Grade the following with reference to a visible grading scale: bulbar and limbal, hyperaemia; limbal neovascularisation; conjunctival papillary redness and roughness (in white light to assess colouration with fluorescein instilled to aid visualisation of papillae/follicles);[24] blepharitis; meibomian gland dysfunction; and staining (both corneal and conjunctival) at every visit. The type of staining used should always be recorded and when staining is present, a sketch denoting the position, shape and depth of the affected area should be included. It should be noted when using fluorescein that the spectral radiance peak of cobalt blue illumination is typically between 452 and 484nm, much below the optimum excitation wavelength of 495nm and likewise yellow filters without a sharp band pass at 500nm will reduce the imaging of excited fluorescein molecules.[25]

Record by grading, sketching or photographing (as felt appropriate) other anterior eye features only if they are remarkable, but indicate that the key tissue which have been examined such as lids and lashes, conjunctiva/sclera, cornea, iris and crystalline lens (a proforma paper or electronic record card may aid this) as nothing recorded is considered to indicate nothing was done.

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