COMPARISON OF AN OBJECTIVE METHOD OF MEASURING BULBAR REDNESS TO THE USE OF TRADITIONAL GRADING SCALES

Luigina Sorbara, Trefford Simpson, Desmond Fonn

Centre for Contact Lens Research, School of Optometry, University of Waterloo, Canada

Introduction

The clinical judgment of ocular redness is complex and poorly understood. In clinical research and practice, grading scales are commonly used to categorise the severity and advancement of clinical conditions. It is important, in clinical decision making, to use grading systems that possess both high discrimination and reliability, and are quick and simple to use.

Typically, the eye is judged based on a scale (which implies measurement) although some scales are used only in descriptive ways. Some qualitative integer grading systems lack the sensitivity needed to detect clinically meaningful change. These scales often have reference benchmarks that are not evenly spaced[1], thus lacking the standardised reference criteria that would increase inter- and intra-observer reliability[2]. At present, subjective classification of slit lamp observations such as conjunctival hyperemia[2] and cataract[3] have been improved by the use of standardised photographic systems instead of the traditional integer scaling systems.

Little is known about how clinicians perform these types of judgments and with few exceptions (e.g., McMonnnies and Chapman-Davies, and Chong et al) nothing is known about the performance of the scales used to assign clinical grades.

There have been attempts to perform clinical redness grading using automated methods. These typically involve examining the structure in a particular area to determine the characteristics of the vessels (Guillon & Shah, Willingham et al., Owen et al.) . These algorithms measure local variations in luminance.

In this study we compared clinical grading of ocular redness to simple photometric measures (chromaticity). Previously described (Simpson et al, AAO 1998) the chromaticity measures will use the CIEu* measures.

Aims

To analyse and compare two clinical grading systems:

- an objective system using photometric measures of redness
- a subjective system based on a 0 to 100 grading scale

Subjects

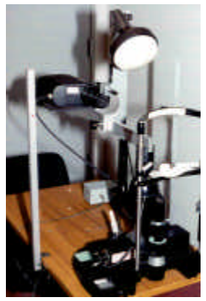
Twenty four subjects, wearing a high Dk silicone hydrogel lens in one eye for a six month period were studied. The subjects had no contact lens experience over the past five years.

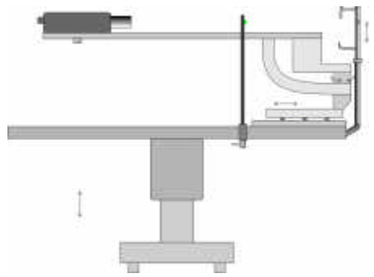
Methods

Objective Measure of Bulbar Redness:

The Spectrascan® 650 Photometer by Photoresearch® was used under fixed illumination conditions. The camera was mounted on a slit lamp base with a chin and forehead rest. The subject fixated an LED on the nasal or temporal sides of the photometer. The examiner positioned the measuring spot, which covers a circular area of 5mm on the bulbar conjunctiva, about 2mm from the limbus. The photometer was focused on the bulbar surface using a joystick. The focus of the objective lens and the lateral position of the instrument were kept constant. Measurements (once on the temporal and once on the nasal) conjunctiva of both eyes were recorded.

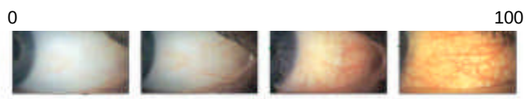
A photo and diagram of the set-up of the spectro-radiometer are found below. The measuring area of the spectro-radiometer is a circular area of approximately 5 mm diameter. Since the spectral radiance measure was taken in the middle of the grading area it was presumed to provide a good example for the overall interpalpebral bulbar redness.





Subjective Grading of Bulbar Redness:

The examiner graded the nasal and temporal bulbar conjunctiva of each image on a 100 point scale using the CCLRU bulbar conjunctiva redness scale as reference. Grading was derived from the overall impression of the anterior bulbar area. The participant was asked to look to the left and right side to give the grader a good impression of the whole nasal and temporal bulbar region.



Data Analysis

Systat 5.1 was used for the analyses. Pearson R tests were used to calculation the correlations.

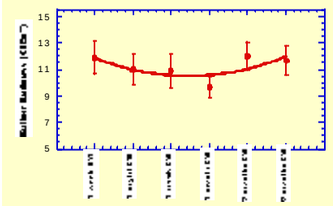
Results

Figure 1 a and b are examples of low amounts of bulbar hyperemia that were graded using both subjective and objective means.

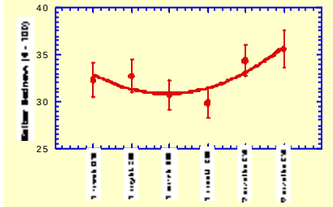
Bulbar Redness Over Time, Objective and Subjective Results

The following figures below illustrate the relationship between time (horizontal axis) and objective grading for the subjects and the subjective grading.

Objective Measurement of Bulbar Redness

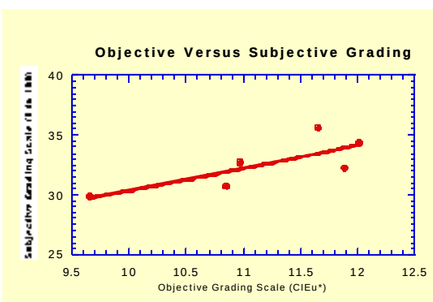


Subjective Measurement of Bulbar Redness



Correlation Between Objective and Subjective Bulbar Redness

The correlation between the objective and subjective scales was R=0.795. This moderate correlation value can be accounted for by the fact that the range of bulbar redness in this study was low and its subjective graded results were quite variable (±SE).



The figure above shows the relationship between subjective clinical redness and objective redness for all subjects.

Table 1 summarises the objective and subjective ocular redness results. The next table i.e. Table 2 indicates the correlation coefficients that were calculated.

Table 1: The average photometric or objective results and the clinical or subjective grades of all of the subjects.

	Wearing Time in Days					
Mean of Nasal and Temporal Redness (± SD)	7	8	15	36	96	186
Objective Measure (CIEu)	11.9 ± 6.0	11.0 ± 5.5	10.9 ± 6.2	9.7 ± 4.1	12.0 ± 5.1	11.7 ± 5.3
Subjective Measure (CCLR)	32.3 ± 8.7	32.7 ± 8.3	30.7 ± 7.7	29.9 ± 7.9	34.4 ± 8.1	35.6 ± 9.3

Table 2: Correlation coefficients illustrating the association between objective and subjective grading and wearing time for all subjects.

Correlations by Visit		
Correlations	R	P-value
Objective Measure (CIEu)	.723	>0.05
Subjective Measure (CCLR)	.853	<0.05

Conclusions

1. Bulbar redness information can be accurately determined objectively as the measurements with the photometer appeared to follow the same trends as the subjectively graded data. It could potentially replace subjective scales in multi-centre studies, where variability by investigator may occur.

2. Perhaps, the subjective grading of ocular redness has less to do with very specific judgements about local variations in redness (e.g., vessel thickness and tortuosity) and more to do with a combination of background redness (microvascular engorgement) as well as large vessel characteristics and thus the moderate correlation when compared with the objective method.

3. In this study there were low amounts of bulbar redness with the silicone hydrogel lenses and possibly there is more variability in grading ocular redness using subjective grading scales.

Acknowledgements

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