



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



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## 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<sup>1</sup>, thus lacking the standardised reference criteria that would increase inter- and intraobserver reliability<sup>2</sup>. At present, subjective classification of slit lamp observations such as conjunctival hyperemia<sup>3</sup> and cataract<sup>3</sup> 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., McMonnies 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 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 red eyes to simple photometric measures (luminance and chromaticity). Previously described (AAO 1998). We refer to the luminance/ chromaticity measures as CIEu measures.

## Aims

To analyse and compare two clinical grading systems:

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

## Subjects

Twenty four subjects, wearing a high Dk silicone hydrogel lens in one eye and a HEMA lens in the other 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.

Photo and 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.

## 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 Subjective and Objective Results:

Figure 1a Silicone Hydrogel

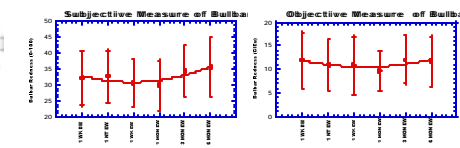
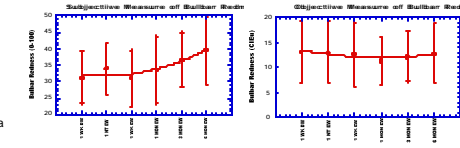
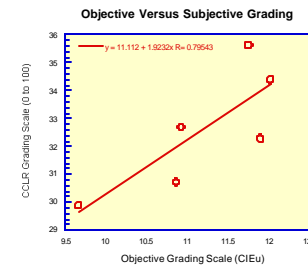


Figure 1 b HEMA



The figures above illustrate the relationship between time (horizontal axis) and clinical grading for the subjects and objective grading (Figure 1a and Figure 1b) for both lenses.

### 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 but, its graded results were quite variable. The variability can be seen by the large standard deviations on the above graphs.

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

The clinical grades of all of the subjects was the one group and the objective measures in Table 1 comprised the other group.

Silicone Hydrogel	Wearing Time in Days					
Mean of Nasal and Temporal Redness (±SD)	7	8	13	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)	32.1 ± 8.7	32.7 ± 8.1	31.7 ± 7.7	29.9 ± 7.0	34.4 ± 8.1	35.6 ± 9.1

HEMA	Wearing Time in Days					
Mean of Nasal and Temporal Redness (±SD)	7	8	13	36	96	186
Objective Measure (CIEu)	13.2 ± 6.3	13.0 ± 6.2	12.7 ± 6.0	11.3 ± 4.8	12.2 ± 5.1	12.8 ± 6.0
Subjective Measure (CCLR)	31.2 ± 7.9	33.9 ± 7.7	30.9 ± 8.6	33.6 ± 10.2	36.7 ± 8.3	39.6 ± 10.3

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

Correlations by Visit		
Correlations	R	P-value
Objective Measure (CIEu) Si Hydrogel	.723	>0.05
Objective Measure (CIEu) HEMA	.772	>0.05
Subjective Measure (CCLR) Si Hydrogel	.853	<0.05
Subjective Measure (CCLR) HEMA	.926	<0.05

## Conclusions

1. Bulbar redness information can be accurately determined photometrically as the trends over visit appeared to follow the same trends as the subjectively graded data..
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 especially with the silicone hydrogel lenses and thus there is more variability using subjective grading scales, whereas if there were larger amounts of bulbar redness detected the subjective scales would be less variable and thus more apt to correlate better with the photometric scales..

## References

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