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Comparison of the compensation comparison method and the direct compensation method for straylight measurement

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The aim of this study was to assess the agreement between the two techniques to facilitate comparison of published clinical data with two well-known instruments, the C-Quant and the van den Berg straylight meter. Data from 35 subjects (41.6 ± 21.7 y.o.) were obtained with both instruments and compared with two tailed paired sample t-test and Bland-Altman plots. The correlation observed between instruments for the three eccentricities of the straylight meter was weak (S: $r^2=0.13$, $p=.03$; M: $r^2=0.33$, $p<.001$; L: $r^2=0.36$, $p<.001$). Coefficients of agreement at each eccentricity were respectively: S=0.58, M=0.49, L=0.49 and associated limits of agreement defined a large interval in comparison to the expected scatter value for a normal person (≥ 0.9). As a conclusion, no direct equivalence can be made and comparison in a clinical study between CQ values anticipated/obtained and previously published straylight values should be done carefully.

Keywords: straylight, scattering, C-Quant.

1. Introduction

The van den Berg straylight meter [1] was used to assess forward light scattering (FLS) in a large variety of conditions and pathologies. Although still present in some research laboratories, it was gradually replaced by the more robust C-Quant [2]. The two instruments share similarities (compensation comparison method for the first one, direct compensation method for the second) but no published data is available on the agreement between the two methods. The purpose of this study was to assess quantitatively the agreement between the two techniques to facilitate comparison of clinical data obtained with each instrument.

2. Methods

Thirty five healthy subjects aged from 19 to 77 years old (mean \pm SD: 41.6 ± 21.7) were recruited from the student and staff populations of the University of Manchester. Young and older participants were studied as a single group to obtain data reflecting a broad spectrum of straylight value. Any history of ocular disease or ocular pathology was considered as exclusion criteria. FLS

values from all subjects were measured monocularly in both eyes with the C-Quant and the van den Berg Straylight meter (for each three different eccentricities of the scattering source $S=3.5^0$, $M=10^0$, $L=28^0$). However, only data obtained from the right eye was considered for calculations. Scatter values from both instruments were then compared with two tailed paired sample t-test and Bland-Altman plots. Pearson's correlation coefficients, coefficients of agreement and limits of agreement were calculated.

3. Results

The data obtained for the C-Quant and the three eccentricities of the Straylight meter is presented in Table 1. It is appreciable that mean straylight values obtained for the Straylight meter decrease as the measured scatter angle increases. This tendency has been previously reported [3].

A weak linear correlation was found between instruments for the three eccentricities (S: $r^2=0.13$, $p=.03$; M: $r^2=0.33$, $p<.001$; L: $r^2=0.36$, $p<.001$). This correlation is illustrated in Figure 1 for the second eccentricity (M). The outcomes of the t-tests are for each eccentricity respectively: C-Quant and S ($t(34)=0.77$, $p=0.45$), C-Quant and M ($t(34)=-1.14$, $p=0.26$), C-Quant and L ($t(34)=-2.2$, $p=0.035$).

In order to gain a better understanding of the relation between the CQ and Straylight meter data sets, the associated Bland-Altman plots (difference CQ-straylight results plotted against the associated mean) were analysed. The spread of the data representing differences of the values between the two instruments with respect to the mean did not show any direct relationship between the two instruments for each one of the eccentricities as illustrated in Figure 1 for the second eccentricity (M).

Coefficients of agreement for the C-Quant and Straylight meter at each eccentricity were respectively: $S=0.58$, $M=0.49$, $L=0.49$. Limits of agreement for each eccentricity defined a large interval in comparison to the expected scatter value for a normal person (respectively: $[-0.54, 0.62]$, $[-0.54, 0.44]$, $[-0.58, 0.40]$).

Table 1 – Summary of the mean values, standard deviation (SD), minimum and maximum values obtained for C-Quant (CQ) and the 3 different eccentricities of Straylight meter (S, M, L)

	CQ	S	M	L
Mean	1.08	1.12	1.04	0.99
SD	0.29	0.22	0.24	0.25
Min	0.72	0.62	0.58	0.51
Max	1.93	1.62	1.69	1.45

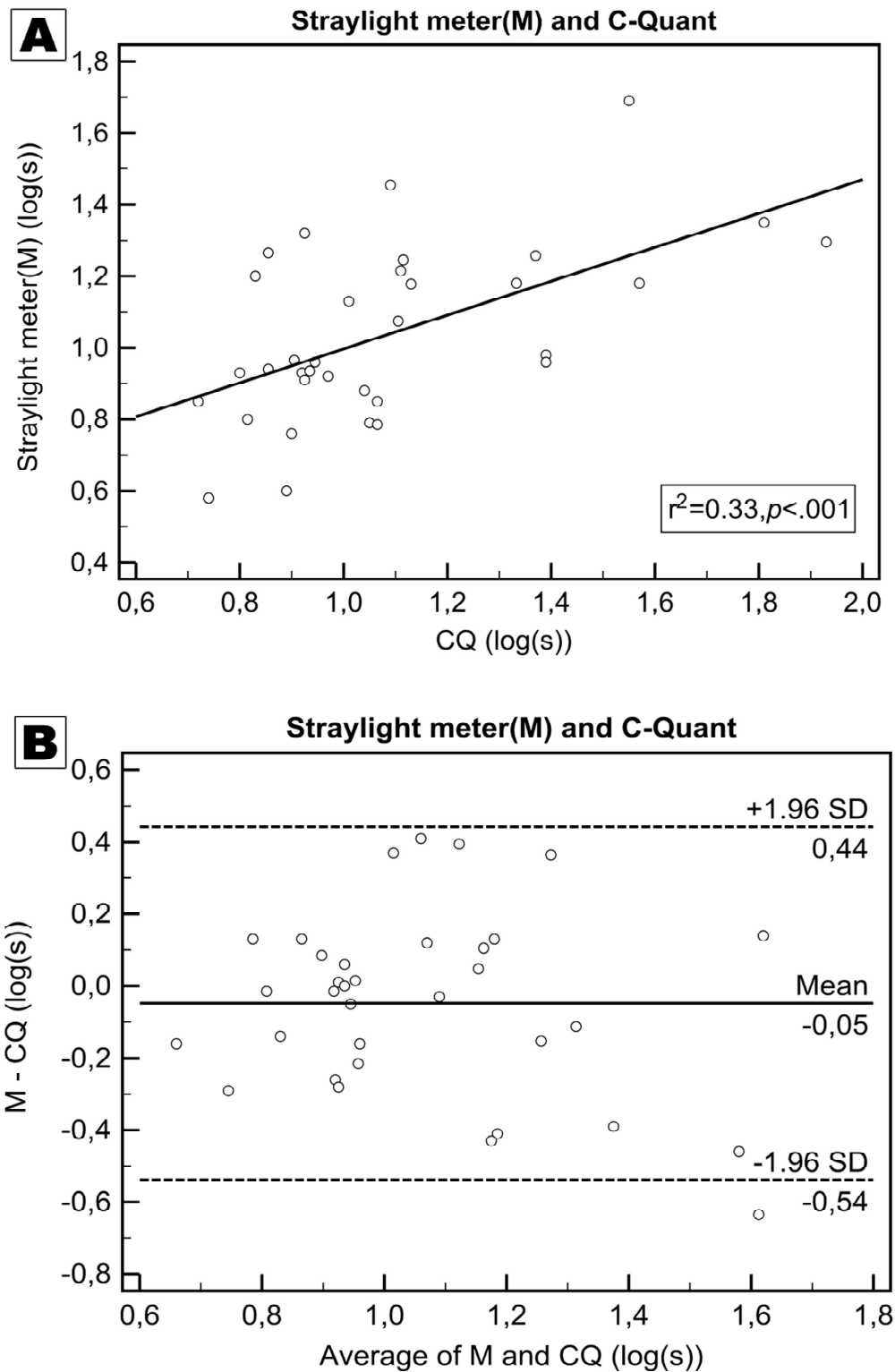


Figure 1 – A) Scatter values obtained with the straylight meter at the second eccentricity ($M=10^0$) vs C-Quant values. Pearson's correlation coefficient and p value are shown on the graphs. A weak relationship can be observed between values obtained from both instruments. B) Differences of the measurements between the two methods plotted against their mean values (for $M=10^0$). Mean value of the differences and limits of agreement (defined as mean of the differences $\pm 1.96 \times \text{SD}$) are also presented.

4. Conclusions

The results from the 2 instruments obtained in this study are broadly in agreement with published literature values. Correlation between the straylight meter and the C-Quant (eccentricity ~ 7 degrees) was shown to be good and statistically significant for each eccentricity although none in particular (S: 3.5deg $r^2=0.13$, $p<0.03$; M: 10deg; $r^2=0.33$, $p<0.01$; L: 28deg; $r^2=0.36$, $p<0.01$). Theoretically a higher correlation with ring M should have been obtained but this can be explained by the limited number of subjects and the variability of the measure.

Further data analysis suggests however that the values obtained with the 2 instruments are not directly interchangeable. The limits of agreement for each eccentricity were respectively equal to or larger than 0.49. This mean that for a given measurement with the C-Quant, the interval where we can expect the straylight meter value to fall is too large to be clinically useful (e.g. for the M eccentricity, straylight meter's results should be -0.54 smaller or +0.44 greater than the CQ value).

The differences between the measurements obtained using the 2 techniques may be due to a variety of factors. Firstly, the eccentricity of the glare source is not strictly identical and the type of glare source used also varies. The Straylight meter is based on a ring of LEDs when the C-Quant uses 2 half discs and a ring. Perhaps more importantly, both instruments rely on a subjective test and measured values cover slightly different ranges. As a result, the standard deviation of the measurement is increased which can affect negatively the agreement between the two methods. This is particularly true for the straylight meter which does not benefit from the improvements present on the C-Quant (computerized 2-choices forced tests, measure of reliability).

As a conclusion, although CQ values are approximately of the same order of magnitude as the straylight meter ones, no direct equivalence can be made. Comparison in a clinical study between CQ values anticipated/obtained and previously published straylight values should be done carefully.

References

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