Novel method to evaluate the tear flow velocity by using a corneal topographer

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Introduction:

The use of an objective analysis and measuring system in contact lens fitting is becoming increasingly important. One advantage of objective measurement is that it does not depend on the subjective rating of an examiner. An important part of a comprehensive tear film analysis is concerned with the tear flow behaviour of the precorneal tear film. Previous analyses of the tear film dynamics are subjective and they are based on the experience of the examiner. Furthermore, there is no classification of the tear flow behaviour. The ability of an objective measurement of the particle velocity should be shown in this pilot study.

Purpose:

Aim of the study was to develop and test a novel method to evaluate the tear flow rate using tear film particles imaged with a corneal topographer. The results were used in preparation for a subsequent objective analysis to classify tear film quality.

Methods:

The illumination of the corneal topographer was adapted to evaluate the tear flow behaviour of the tear film by tracking the particles contained therein. The illumination system consisted of eight white LEDs (grouped in two pairs, nasal and temporal).

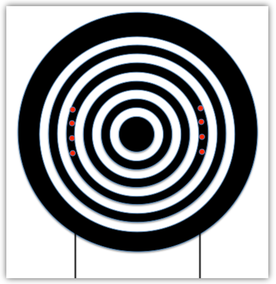

Figure 1: Adapted illumination topographer

Figure 2: Tear flow behaviour slitlamp

Thirty-four subjects (mean age 37.1±19.1 years; male 38%, female 62%) participated in this pilot study. A subjective slit lamp examination of the particles was performed as a comparator. To classify the tear flow behaviour, established methods for tear film analysis were used: tear meniscus height (TMH), lipid interference pattern, Phenol red test (PRT). Particles were tracked manually to establish a basis for the later development of automatic tracking. This tracking was carried out, by means of using the *VIANA* software (Version 3.64, University Essen) which calculated the tear flow velocity.

Results:

The median of the tear flow measured with the topographer was 1.19 mm/ s (mean=1.10±0.39 mm/ s) after 1 second, the median assessed with the slit lamp was 1.15 mm/ s (mean=1.24±0.47 mm/ s).

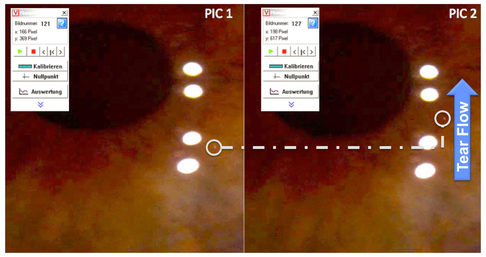

Figure 3: Tear flow behaviour topographer

Particle movement was found to be normally distributed (*Shapiro-Wilk*-Test) with both the topographer method (p=0.365) and the slitlamp reference (p=0.216).

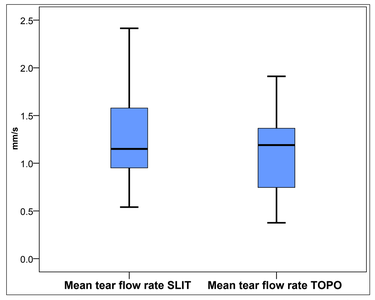

Figure 4: Comparison of tear flow velocities (n=34)

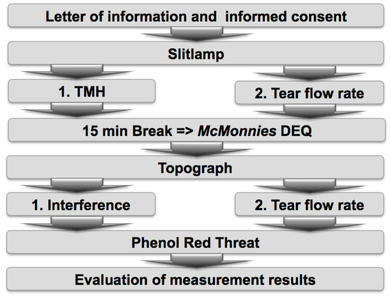

Figure 5: Study schedule

No significant difference between the methods (p=0.113, t-Test) was found and the results correlated significantly (r=0.347, p=0.044). However, no significant correlations between particle velocity and established tear film quality or volume metrics (TMH; lipid interference pattern; PRT) were identified (p > 0.05).

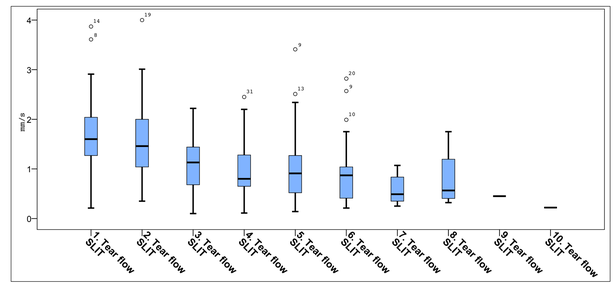

Figure 6: Tear flow rate slitlamp after blinking (n=34)

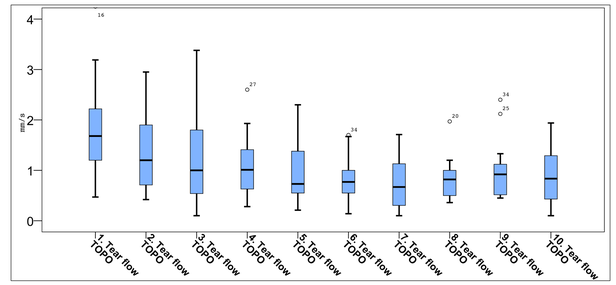

Figure 7: Tear flow rate topographer after blinking (n=34)

Conclusion:

Adapted illumination of the topographer allows subjective measurement of the tear flow, equivalent to the measurement with a slit lamp. However, particle movement does not relate to traditional measures of tear film quality and quantity. Next step will be to analyse objectively the tear particle movement in order to determine its repeatability. Examination of the relationship between tear film velocity and tear film quality will be observed in further studies.

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