Correlates of Subjective and Objective Measures of Ocular Discomfort

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Introduction

- The success of contact lens wear is determined by the subjective comfort experienced with the lenses
- Comfort with contact lens wear is generally assessed using subjective rating scales like visual analogue scales[1] or numerical rating scales[2]. No objective anchor/measure has been established for the discomfort experienced on the ocular surface.
- Non contact pnuematic esthesiomery[3] provides a way to produce discomfort on the ocular surface by delivering pneumatic stimuli with systematically varying flow rate to produce a corresponding weak to strong sensation of discomfort.
- Psychophysical scaling methods help to quantify these sensations and relate the quantitative measures of sensation to the quantitative measure of physical stimuli.
- Magnitude matching[4] is a psychophysical scaling method enabling subjects to adjust the intensities of qualitatively different stimuli so their sensation magnitudes match.

Purpose

- To study the correlations between subjective and objective measurements of ocular discomfort.

Materials & Methods

- 27 participants were enrolled in this psychophysical magnitude matching study.
- Discomfort was induced using pneumatic stimuli delivered by a computer controlled Belmonte Esthesiometer to one eye, and a soft contact lens on the other eye.
- Soft (HEMA) contact lenses of nine different lens designs varying in base curve and diameter were used in the study. Eight lenses were randomly chosen and fitted on all participants to produce discomfort of varying intensities.
- The study was conducted on two separate days with four lenses randomly assigned on each day.

Materials & Methods

- Subjective measurements of discomfort were obtained using numerical rating scales with 0 indicating no discomfort and 100 indicating worst discomfort imaginable.
- The central corneal mechanical threshold was first measured using the ascending method of limits.
- The assigned contact lens was fitted on one eye and the equivalent corneal discomfort was matched on the fellow eye using stimuli delivered from the esthesiometer.
- Participants rated the discomfort arising from the pneumatic stimuli and the contact lens discomfort
- Stevens' power functions[4] were used to examine the relationships between the objective esthesiometer stimulus match to the subjective sensation reported with the contact lens.
- Pearson product moment correlation was used to correlate the objective esthesiometer stimulus intensity to the subjective ratings of discomfort reported by each participant.

Results

- 14 out of 27 participants showed statistically significant correlation between the subjective and objective measures of discomfort (correlation ranged from 0.71 to 0.89). The remaining subjects showed a correlation between -0.04 to 0.70, which were not statistically significant.
- Non Linear regression was used to fit the discomfort with contact lenses and the corresponding intensity of pnuematic stimuli that produced equivalent discomfort, using Stevens' power function:

$$\Psi = K\,(\Phi)^{b}$$

where Ψ is the subjective magnitude of discomfort, Φ is the strength of the pneumatic stimuli causing the discomfort. K is the constant and b is the power exponent.

- The average exponent for the power function relating the subjective and objective measures of discomfort was 1.40

Results

Demonstration of internal validity of discomfort from contact lens and esthesiomerter

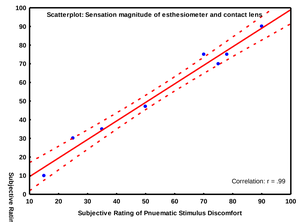

Fig 1: Association between subjective sensations from the contact lens and matched pnuematic stimulus intensities

Functional relationship between stimulus intensity and subjective discomfort of contact lenses

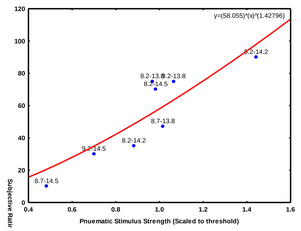

Fig 2: Sample data from a single participant with subjective ratings of contact lens discomfort as a function of stimulus intensity. This shows an accelerating function, depicting an increase in contact lens discomfort with increase in pneumatic stimuli strength .

Average canonical grading scale relating subjective (contact lens) rating to objective (threshold scaled) esthesiometer matches

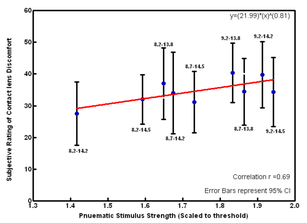

Fig 3: Mean subjective Ratings of contact lens discomfort as a function of stimulus intensity for all the participants in the study

Discussion

- The relationship between the subjective sensation with contact lenses and the objective stimuli from esthesiometer appears to follow Stevens' power law in half of the participants.
- Inter-individual differences do exist in this type of sensation magnitude estimation. These may be due to differences in judgmental and sensory processes[5,6]
- Differences in numeric response preference such as the influence of absolute numbers chosen, range of numbers used and whether the numbers are linearly applied to the sensation magnitude also perhaps play a role in magnitude matching experiments[6].

Conclusions

- Subjective ratings of ocular discomfort can be scaled by corneal esthesiometry in a selected sample of people.
- In the subset of subjects with poorer correlations, perhaps the pneumatic mechanical stimulus was too localized and specific to match the complex sensations experienced while wearing contact lenses
- However, there is also a group of subjects who are poor at making judgments about ocular comfort. Perhaps sensory panels should be used when ocular discomfort is the primary outcome.

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