Impact of a Soft Contact Lens for Controlling Myopia Progression on Accommodative Response and Convergence
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Background
- With the increase of prevalence of myopia world-wide, several optical and pharmacological interventions have been investigated for their effectiveness in myopia control including the use of soft contact lenses.
- All soft contact lenses used in myopia research attempt to control myopia progression by addressing retinal hyperopic defocus through introducing “plus power” in the lens design.
- Research questions:
  1. How does the accommodative and convergence system of a young patient respond to the “multifocality” of the lens?
  2. Is the lens myopia control efficacy contingent on the eye’s accommodative response?

Methods
- One-year randomized, controlled, double-masked myopia control clinical trial.1
- Age: 8 to 11 years; n=127; Test = 64; Control = 63
- Study lenses (daily disposable, etafilcon A):
  - Control: conventional spherical design
  - Test: with positive spherical aberration
- Endpoints: (Baseline; LOE 1-week; LOE 1-year)
  - Slope of accommodative response (SAR) curve with 1 to 4D target vergence (WAM-5500 by Grand Seiko)
  - Horizontal phoria (Von Graefe method measured at 33cm and 6m) & Stimulus AC/A (gradient method at 33cm)
- Statistical analyses (LMM)
  - Comparison between bare eye and lens-on-eye (LOE) for each lens type at each time point
  - Comparison between test and control lenses at each follow-up
  - Correlation between SAR and myopia progression after 1 year (axial elongation (AE) and change of spherical equivalent power (Rx), respectively)

Results

SAR (Continued)
- No significant difference in SAR at baseline between test and group groups (p=0.843).
- Compared to baseline, LOE SAR of the test group was significantly flatter at 1-week (p=0.000) and 1-year (p=0.000); LOE SAR of the control group was not significantly different from baseline at 1-week (p=0.642) but was flatter at 1-year (p=0.000).
- With LOE, SAR of the test group was significantly flatter than the control group at both 1-week (p=0.000) and 1-year (p=0.000).

Correlation of Myopia Progression & SAR

Slope of Accommodative Response

Figure 1: Accommodative response curves of bare eye at baseline and LOE at 1-week and 1-year for the test (blue) and control (red) groups.

Figure 2: 1-year myopia progression (top; AE; bottom; Rx change) as a function of SAR for the test (blue) and control (red) groups.
- SAR was a significant predictor for myopia progression (AE: p=0.000; Rx change: p=0.019)
- SAR by Lens interaction was a significant predictor for AE (p=0.017), but not for Rx change (p=0.089).
- Steeper SAR was associated with less AE and Rx change

Horizontal Phoria and AC/A
- At baseline, no significant difference in phoria or AC/A was found between test and control groups.
- With LOE, distance and near phoria in the test group appeared to be more exophoric than the control; No significant difference was found in AC/A between two groups.

Table 1: (Mean (95% CI) of Difference of Distance and Near Phoria, AC/A between Test and Control Groups

Conclusion
- The soft contact lens with +SA for controlling myopia progression resulted in an apparent decrease in accommodative response of the eye, which may have contributed to a small amount of exophoric shift in the test lens group.
- Within the treated group, reduced accommodative response seemed to correlate with more myopia progression, suggesting some subjects may have utilized the +SA to some extent for near viewing leaving hyperopic defocus at the retina.
- Finding is consistent with the hypothesis that hyperopic defocus at the retina is associated with myopia progression.
- The interactions between a lens' optics and the eye's convergence and accommodative system may impact the lens myopia control efficacy, and should be considered during the design of myopia control lenses.

Reference