ABSTRACT

Purpose: Evidence continues to accumulate regarding the role of the peripheral retina for regulating eye growth. Corneal reshaping contact lenses have been shown to effectively slow eye growth, and the hypothesized mechanism of treatment effect is relative peripheral myopia. Soft bifocal contact lenses with a distance center may provide a similar effect as corneal reshaping. The purpose of this study is to examine the one-year myopia control effects of soft bifocal contact lenses with a distance center.

Methods: 40 children with -1.00 to -6.00 D myopia, less than -1.00 D astigmatism, and healthy eyes were fit with Proclear Multifocal “D” lenses with a +2.00 add. This two-year study will compare the cyclogeic spherical equivalent myopic progression between the children wearing soft bifocal contact lenses to a historical control group matched on age and gender who wear soft spherical contact lenses. These results include only information from the right eye.

Results: Forty children were fit with soft bifocal contact lenses, and 28 have completed one year. Eight children have been discontinued (5 were lost to follow-up, 2 moved, and 1 had difficulty with insertion), and four have not yet completed one year. These results include only the 28 subjects and the matched controls. The average (±SD) age was 10.8 ± 0.75 years and 10.9 ± 0.88 years (p = 0.58), the average spherical equivalent was -2.45 ± 1.03 D and -2.29 ± 0.98 D (p = 0.56), and the average axial length was 24.3 ± 0.94 mm and 24.3 ± 0.94 mm (p = 0.62) for the soft bifocal and spherical contact lens wearers, respectively. After one year, the change in spherical equivalent was -0.39 ± 0.53 D for the soft bifocal wearers and -0.60 ± 0.32 D for the soft spherical wearers (p = 0.08). The change in axial length was 0.17 ± 0.21 mm for the soft bifocal wearers and 0.23 ± 0.17 mm for the soft spherical wearers (p = 0.32). With a sample size of 28 subjects, we have 75% power to detect a 50% reduction in spherical equivalent refractive error with a standard deviation of 0.50 D and assuming alpha = 0.05.

Conclusion: Over one year, the myopia progressed 35% slower for the soft bifocal contact lens wearers, but the results are not statistically significant for either the spherical equivalent refractive error progression or the axial elongation. The presentation will include a complete one year dataset and partial two-year results.

INCLUSION CRITERIA

- Sphere: -1.00 D to -6.00 D
- Cylinder: Less than 1.00 DC
- 20/20 or better best-corrected visual acuity in each eye
- No gas permeable contact lens wear
- No ocular or systemic health problems that could affect contact lens wear

METHODS

- Age- and gender-matched to soft spherical lens wearer from ACHIEVE Study
- Baseline and annual examinations
- Cycloplegia: 25 minutes after two drops of 1% tropicamide, separated by 5 minutes
- Refractive error: 10 autorefractor readings while fixing 20/30 letters located beyond infinity on Badal track
- Axial length: five a-scan ultrasounds with equal lens peaks and abrupt retinal spike
- Average of two eyes

CONTACT LENSES

<table>
<thead>
<tr>
<th>Contact Lenses</th>
<th>Soft Bifocal</th>
<th>Soft Spherical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand</td>
<td>Proclear Multifocal “D”</td>
<td>Stellest A</td>
</tr>
<tr>
<td>Material</td>
<td>Silhouette A</td>
<td>Silhouette A</td>
</tr>
<tr>
<td>Wt. Content</td>
<td>72%</td>
<td>72%</td>
</tr>
<tr>
<td>Add Power</td>
<td>+2.00</td>
<td>N/A</td>
</tr>
<tr>
<td>Replacement</td>
<td>Monthly</td>
<td>Daily</td>
</tr>
<tr>
<td>S/C</td>
<td>1/1</td>
<td>1/1</td>
</tr>
</tbody>
</table>

BACKGROUND

- Eye growth influenced by location of focus of light
- Peripheral retina is more important to control eye growth than previously believed to be true
- Corneal reshaping contact lenses slow eye growth in myopic children
  - Mechanism of treatment effect is thought to be peripheral myopic blur

- Distance center soft bifocal contact lenses provide similar topographic profile as corneal reshaping (Figure)

CONCLUSIONS

- 40 subjects enrolled
  - 32 completed one year
  - 14 completed two years so far
- Baseline characteristics: mean ± standard deviation

<table>
<thead>
<tr>
<th></th>
<th>Soft Bifocal</th>
<th>Soft Spherical</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (D)</td>
<td>-2.3 ± 1.80</td>
<td>-2.2 ± 0.97</td>
<td>0.73</td>
</tr>
<tr>
<td>S (D)</td>
<td>-0.02 ± 0.21</td>
<td>-0.07 ± 0.15</td>
<td>0.14</td>
</tr>
<tr>
<td>C (D)</td>
<td>-0.04 ± 0.08</td>
<td>0.06 ± 0.08</td>
<td>0.34</td>
</tr>
<tr>
<td>Anterior Chamber Depth (mm)</td>
<td>3.82 ± 0.27</td>
<td>4.01 ± 0.24</td>
<td>0.02</td>
</tr>
<tr>
<td>Lens Thickness (mm)</td>
<td>0.36 ± 0.17</td>
<td>0.36 ± 0.17</td>
<td>0.05</td>
</tr>
<tr>
<td>Vitreous Chamber Depth (mm)</td>
<td>17.00 ± 1.05</td>
<td>16.94 ± 0.84</td>
<td>0.76</td>
</tr>
<tr>
<td>Axial Length (mm)</td>
<td>24.28 ± 0.99</td>
<td>24.30 ± 0.87</td>
<td>0.09</td>
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- One year change: mean ± standard deviation, controlling for baseline Anterior Chamber Depth and Lens Thickness

<table>
<thead>
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<th>Soft Bifocal (n=32)</th>
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<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>-0.37 ± 0.41</td>
<td>-0.31 ± 0.33</td>
<td>0.15</td>
</tr>
<tr>
<td>S</td>
<td>-0.07 ± 0.16</td>
<td>-0.03 ± 0.11</td>
<td>0.08</td>
</tr>
<tr>
<td>C</td>
<td>-0.01 ± 0.10</td>
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<td>0.71</td>
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<td>Anterior Chamber Depth</td>
<td>0.01 ± 0.07</td>
<td>0.00 ± 0.07</td>
<td>0.68</td>
</tr>
<tr>
<td>Lens Thickness</td>
<td>0.02 ± 0.09</td>
<td>0.04 ± 0.06</td>
<td>0.76</td>
</tr>
<tr>
<td>Vitreous Chamber Depth</td>
<td>0.13 ± 0.15</td>
<td>0.22 ± 0.16</td>
<td>0.08</td>
</tr>
<tr>
<td>Axial Length</td>
<td>0.16 ± 0.13</td>
<td>0.21 ± 0.16</td>
<td>0.12</td>
</tr>
</tbody>
</table>

- Two year change: mean ± standard deviation, controlling for baseline Anterior Chamber Depth and Lens Thickness

<table>
<thead>
<tr>
<th></th>
<th>Soft Bifocal (n=28)</th>
<th>Soft Spherical (n=32)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>-0.55 ± 0.49</td>
<td>-1.10 ± 0.54</td>
<td>0.12</td>
</tr>
<tr>
<td>S</td>
<td>-0.15 ± 0.19</td>
<td>-0.06 ± 0.11</td>
<td>0.09</td>
</tr>
<tr>
<td>C</td>
<td>0.01 ± 0.12</td>
<td>-0.02 ± 0.08</td>
<td>0.68</td>
</tr>
<tr>
<td>Anterior Chamber Depth</td>
<td>-0.05 ± 0.10</td>
<td>0.00 ± 0.10</td>
<td>0.67</td>
</tr>
<tr>
<td>Lens Thickness</td>
<td>-0.02 ± 0.13</td>
<td>0.01 ± 0.05</td>
<td>0.34</td>
</tr>
<tr>
<td>Vitreous Chamber Depth</td>
<td>-0.06 ± 0.11</td>
<td>0.04 ± 0.08</td>
<td>0.09</td>
</tr>
<tr>
<td>Axial Length</td>
<td>-0.32 ± 0.16</td>
<td>0.47 ± 0.33</td>
<td>0.18</td>
</tr>
</tbody>
</table>

REFERENCES

7. Walline JJ, Jones LA, Sinnott LF. Corneal reshaping and myopia progression. Br J Ophthalmo-
nal 2009;93:1181-5.
Light Exposure Patterns in Children
- A Pilot Study

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Purpose

• To examine the light exposure patterns of school-aged children in relation to refractive error.

Methods

• School-aged children (13-14 years old, n = 12) were issued with self-contained light meters that recorded the individual light exposure levels every 10 seconds (HOBO Pendant UA-002-064, Onset Computer Corporation, USA) [Fig. 1 and 2A].
• The ambient outdoor light levels were also recorded every 10 seconds over seven days (one period) [Fig. 2B].
• Measurements were made in three periods over three consecutive months in Southern Hemisphere winter (June, July, August).
• Cycloplegic autorefraction and axial length measurements were made at the beginning and end of the three month study.

Results

• Individual light level recordings indicated that children spent only a small amount of time outside (5.88% ± 1.39% of the total time, or 10.65 ± 2.52 hours per week; mean ± 95% CI, n = 12). However, these outdoor periods accounted for a large proportion of their total light exposure (87.95% ± 3.72% of their total light exposure, or 4.72 × 10⁷ ± 1.65 × 10⁷ lux) [Fig. 3].
• The subjects were exposed to only 5.72% ± 1.86% of the total ambient outdoor light on average over the measurement period.
• Refractive Error: Refractive error was not significantly correlated with cumulative light exposure (R² < 0.001) [Fig. 4].
• Change in Refractive Error: There was no significant correlation between the change in refractive error and the cumulative light experienced over the three month measurement period (R² = 0.0069) [Fig. 5].

Conclusions

• A small amount of time spent outdoors is associated with a large proportion of daily light exposure.
• While predictable levels of light exposure are obtained indoors, there is a great degree of variability in the amount of light received outdoors.
• A small amount of extra time spent outdoors can disproportionally affect the total light exposure received per day.
• Further investigations of the quality (e.g. spectral composition) and quantity (e.g. yearly exposure, differing seasons, etc.) of light received by school-aged children are warranted.
The aim of this study was to evaluate the influence of sport activity in the prevalence of myopia and its refractive error. Although in the opposite direction, is similar to what occurs after sustained near work activities, education or light exposure. Rose et al found a significant association between the time spent in outdoor activity and myopia prevalence. This effect, considering the all sample, we found statistical significant changes after one hour of sport activity for all refractive parameters (M, J0 and J45). We verified a hyperopic shift (M= 0.110 D) after the sport activity and an increase of against myopic mean refraction. Some other studies report the same association between outdoor activity and lower myopia prevalence rates and a more hyperopic refractive error. However, these studies fail to prove the association between sport activities and refractive error.

Considering the all sample, we found statistical significant changes after one hour of sport activity for all refractive parameters (M, J0 and J45). We verified a hyperopic shift (M= 0.110 D) after the sport activity and an increase of against myopic mean refraction. This means that the sport activity has less influence in the hyperopes than in the other two refractive groups. Considering each refractive group separately we verify that for the myopes and emmetropes the difference between the measurements obtained before and after one hour of sport activity. Myopes, emmetropes and hyperopes are represented separately.

Considering the all sample, we found statistical significant changes after one hour of sport activity for all refractive parameters (M, J0 and J45). We verified a hyperopic shift (M= 0.110 D) after the sport activity and an increase of against the-refule (or a decrease of with-the-rule) astigmatism (J0=–0.5140 D). For the astigmatism components, despite the differences were statistically significant the clinical significance were not relevant. For the ocular parameters as the corneal curvature, the axial length and the anterior chamber depth, we didn’t found any change statistically significant after the sport activity.

Considering the differences between refractive groups we found that only the variation of the M is statistically significant (p=0.007), being the variation for the myopic group higher than that verified for the other two refractive groups.

Table 1. Mean (mean ± SE) values of the M, J0 and J45 components of refraction, corneal curvature, anterior chamber depth (ACD), and axial length (AL), before and after an hour of sport activity. Mean variations between the two measurements and statistical significance. We present the values for all sample and for myopes, emmetropes and hyperopes, separately.

<table>
<thead>
<tr>
<th>M</th>
<th>J0</th>
<th>J45</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>N</td>
<td>183±180</td>
</tr>
<tr>
<td>J0</td>
<td>110±110</td>
<td>120±120</td>
</tr>
<tr>
<td>J45</td>
<td>90±90</td>
<td>100±100</td>
</tr>
</tbody>
</table>

Figure 1. Graphic representation of the difference between measurements obtained before and after one hour of sport activity. Myopes, emmetropes and hyperopes are represented separately.
Characteristics of multifocal electroretinogram (mfERG) in children with low to moderate myopia
Wing-cheung, Ho; Chea-su, Kee; Henry Ho-lung, Chan
Laboratory of Experimental Optometry (Neuroscience), Centre for Myopia Research, School of Optometry, The Hong Kong Polytechnic University, Hong Kong

**Purpose**
To study functional change in children with low to moderate myopia by using global flash multifocal electroretinogram (mfERG).

**Methods**
Fifty-four children aged from 9 to 14 years (mean = 11 ± 1; median = 11) with refractive errors ranged from plano to -6 D underwent the global flash mfERG measurement at 96% contrast (Figure 1).

The stimulus was made up of 61 hexagons scaled with eccentricity. The amplitude and implicit time of the direct (DC) and induced components (IC) were pooled into 5 regions for analyses (Figure 2). Stepwise multiple regression analysis was used to evaluate the contribution of refractive error and axial length to the mfERG responses.

Increasing axial length significantly reduced DC amplitude at the central region (adjusted R-square = 0.17, F = 12.02, p = 0.001) (Figure 4) but not the other retinal regions. Refractive error could not account for the extra reduction in the amplitude. On the other hand, neither refractive error nor axial length had significant impact on the amplitude of IC and the implicit times of IC and DC for all regions examined.

**Conclusions**
In contrast to our previous study which showed that the paracentral IC responses reduced with increasing degree of myopia in adult1, this study showed that only the central DC responses reduced with longer axial length in children. Further studies are needed to understand the underlying mechanism.

**Acknowledgement**
This study was supported by the associated fund (Research Postgraduate), the Niche Areas – Glaucoma Research (J-BB76) and Myopia Research (J-BB78) from The Hong Kong Polytechnic University.

**Reference**
Ho WC, Ng YF, Chu PHW, Fong YY, Yip KS, Kee CS, Chan HHL. Impairment of retinal adaptive circuitry in the myopic eye. Vision Research. (under review)
Two year follow-up of refractive error progression and optical component changes of college students

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1SOMO Optical Co, Seoul Korea, 2) Graduate school of Eulji University, 3) School of Medicine Eulji University, 4) Daejeon Health Science College, 5) College of Health and Sports Science, Daejeon University.

PURPOSE

To elucidate which aspects affect refractive error progression in young adulthood.

METHODS

Cycloplegic refractive error was measured by Canon RK-F1. And anterior chamber depth(ACD), corneal radius(CR) and axial length(AL) were measured by IOLMaster on 74 eyes of 37 young adults in 2008 and 2010. Initial age ranged between 18 and 21.

RESULTS

Table 1. Mean values of ocular components in 2008 and 2010.

<table>
<thead>
<tr>
<th>Variables</th>
<th>2008 (n=74 eyes)</th>
<th>2010 (n=74 eyes)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>SER (D)</td>
<td>-2.46 ± 2.823</td>
<td>-2.77 ± 3.153</td>
<td>0.305 ± 0.430</td>
</tr>
<tr>
<td>CR (mm)</td>
<td>7.779 ± 0.244</td>
<td>7.775 ± 0.251</td>
<td>0.004 ± 0.035</td>
</tr>
<tr>
<td>ACD (mm)</td>
<td>3.760 ± 0.227</td>
<td>3.758 ± 0.245</td>
<td>0.002 ± 0.069</td>
</tr>
<tr>
<td>AL (mm)</td>
<td>24.722 ± 1.439</td>
<td>24.767 ± 1.446</td>
<td>-0.044 ± 0.188</td>
</tr>
<tr>
<td>AL/CR ratio</td>
<td>3.178 ± 0.168</td>
<td>3.185 ± 0.171</td>
<td>-0.007 ± 0.028</td>
</tr>
</tbody>
</table>


Myopia increased by an average of 0.305±0.430D(t=6.115, p=0.000) between 2008 and 2010(Table 1). A significant correlation was found between changes in SE and CR(r=0.282, p=0.015) and in SE and AL/CR ratio(r=-0.240, p=0.039). But no significant correlation between change in SE and AL(r=-0.102, p=0.388) was found(Table 2).

The results of ordinal correlation(pearson’s) for variable constants in ocular components changes.

<table>
<thead>
<tr>
<th></th>
<th>SER</th>
<th>CR</th>
<th>ACD</th>
<th>AL</th>
<th>AL/CR</th>
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</thead>
<tbody>
<tr>
<td>SER (D)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>r</td>
<td>1.000</td>
<td>0.282*</td>
<td>0.076</td>
<td>-0.102</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.015</td>
<td>0.522</td>
<td>0.388</td>
<td>0.039</td>
</tr>
<tr>
<td>CR (mm)</td>
<td></td>
<td>0.282*</td>
<td>1.000</td>
<td>0.295*</td>
<td>-0.004</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.015</td>
<td>0.011</td>
<td>0.972</td>
<td>1.000</td>
</tr>
<tr>
<td>ACD (mm)</td>
<td></td>
<td>0.076</td>
<td>0.295*</td>
<td>0.000</td>
<td>0.016</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.015</td>
<td>0.011</td>
<td>0.010</td>
<td>0.891</td>
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<tr>
<td>AL (mm)</td>
<td></td>
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<td>0.000</td>
<td>0.138</td>
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<td></td>
<td>p</td>
<td>0.388</td>
<td>0.972</td>
<td>1.018</td>
<td>0.857**</td>
</tr>
<tr>
<td>AL/CR</td>
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<td>-0.240*</td>
<td>0.517**</td>
<td>0.016</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.015</td>
<td>0.011</td>
<td>0.016</td>
<td>0.999</td>
</tr>
</tbody>
</table>


FIGURES

Figure 1. Correlation of ocular component changes in Emmetropic Group.

Figure 2. Correlation of ocular component changes in Myopic Group.

Statistically, myopia progressed the most significantly in myopic group(t=7.599, p=0.000) for two years.

DISCUSSION AND CONCLUSIONS

Changes in SE, corneal radius and AL/CR ratio were significantly correlated each other and changes in CR is the most essential factor for myopia progression in young adults. Myopia progression in young adulthood is more common in myopic eyes. It, therefore, is presumed that adulthood myopia is related to not axial length elongation but corneal radius steepening.
Differential protein expression using two-dimensional salt plug mass spectrometry techniques

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2 Singapore Polytechnic—University of Manchester FSI-Optometry, School of Chemical and Life Sciences, Singapore Polytechnic, Singapore
3 State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Centre, SunYat-sen University, Guangzhou, PR China

Introduction

The risks of myopia emergence and development can be classified to nature and nurture[1]. Chick (Gallus Gallus) as a well-established myopic animal model is used to study the mechanism of nurture in myopia[2]. The rapid advancement of proteomic technology provides a powerful tool and new sight to investigate the effect of proteins in myopic chicks[3]. In this study we aim to study the retinal protein expressions in lenses induced myopia (LIM) and lens induced hyperopia (LIH) chicks using two-dimensional salt plug mass spectrometry (2D-LCMS) coupled with isotope coded protein labelling (ICPL).

Methods

Samples preparation

The right eyes of white leghorn chicks (3 days old, n=5) wore -1OD lens and left eyes with +1OD lens for 3 days. Refractive error and eye parameter before and after the treatment were measured using a streak retinoscope and high frequency ultrasonography respectively. Retina tissues were harvested and homogenized in Guanidine-HCl buffer using a dismembrator with liquid nitrogen. The protein concentration of each retina sample was measured using 2-D Quant Kit™.

Isotope coded protein labelling (ICPL)

Equal amount of proteins from both eyes were labelled with 12C-Nic-reagent (right eye) and 13C-Nic-reagent (left eye) respectively and mixed according to SERVA ICPL Kit. The mixture was in-solution digested by trypsin and endoproteinase GluC overnight.

Two-dimensional (2-D) salt plug

Using HCTUltra IonTrap Mass Spectrometry, 22ug protein mixture was loaded into a strong cation-exchange (SCX) column as a 1st-dimension separation and subsequently separated in a reversed-phase (RP) column for 2nd-dimension separation. The concentrations of NaCl range from 1mM to 1M. After separation the samples were sent to Electrospray Ionization Tandem Mass Spectrometry (ESI-MS/MS) for detection. Peptides labelling for isotope pairing (SIPEL pair detection) and protein quantification were performed in WARP-LCT™ software. International Protein Index (IPI) database of chick was used for peptide sequences searching to get the protein IDs.

Results

Fig. 1 Refractive error and axial length changes (Mean±SEM, n=5) after 3 days lens wearing (R: -1OD & L: +1OD, compared to left eye, ***as p<0.001 using paired t-test).

Fig. 2 ESI-MS/MS results of ICPL data using 2-D salt plug separation. Total 789 proteins were identified, in which 544 protein IDs (70.2%) have paired ratios and 127 IDs have more than 3 paired ratios. 16 protein IDs were selected using our criterion (at least 3 paired-ratios & ratios >1.35 or <0.7).

Table. 1 Differentially expressed protein candidates

<table>
<thead>
<tr>
<th>Expression</th>
<th>Gene Symbol</th>
<th>ratio</th>
<th>protein name</th>
<th>IPI</th>
<th>Homo</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP</td>
<td>MRYV0</td>
<td>2.1±0.38</td>
<td>CBBM1 (Bruch border membrane 1)</td>
<td>326.64</td>
<td>3</td>
</tr>
<tr>
<td>UP</td>
<td>HEB</td>
<td>1.87±0.13</td>
<td>nephrin</td>
<td>765.29</td>
<td>5</td>
</tr>
<tr>
<td>UP</td>
<td>606809</td>
<td>1.05±0.09</td>
<td>gelsolin</td>
<td>318.65</td>
<td>3</td>
</tr>
<tr>
<td>UP</td>
<td>IEF1B</td>
<td>1.04±0.07</td>
<td>kininogen-like 2</td>
<td>163.36</td>
<td>3</td>
</tr>
<tr>
<td>UP</td>
<td>TTN</td>
<td>2.95±0.66</td>
<td>Thin-Connection Fragments (ICPL)</td>
<td>801.69</td>
<td>6</td>
</tr>
<tr>
<td>UP</td>
<td>606562</td>
<td>2.34±0.02</td>
<td>inhibitor of Bruten aminopeptidase, tyrosic kinase</td>
<td>152.84</td>
<td>4</td>
</tr>
<tr>
<td>UP</td>
<td>C8W55</td>
<td>1.74±0.31</td>
<td>cardiac troponin C</td>
<td>477.58</td>
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</tr>
<tr>
<td>UP</td>
<td>TULN</td>
<td>1.4±0.11</td>
<td>T-cell</td>
<td>273.78</td>
<td>3</td>
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<tr>
<td>UP</td>
<td>AK33</td>
<td>2.14±0.86</td>
<td>a-synuclein</td>
<td>478.55</td>
<td>4</td>
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<tr>
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<td>TRPV3</td>
<td>3.85±0.09</td>
<td>transient receptor potential 1</td>
<td>227.45</td>
<td>5</td>
</tr>
<tr>
<td>DOWN</td>
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<td>0.79±0.99</td>
<td>GDF5</td>
<td>196.98</td>
<td>3</td>
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<tr>
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<td>0.10±0.43</td>
<td>synaptotagmin-like 3</td>
<td>158.07</td>
<td>3</td>
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<tr>
<td>DOWN</td>
<td>60656250</td>
<td>0.69±0.05</td>
<td>connexin 43 (Connexin 43)</td>
<td>396.17</td>
<td>5</td>
</tr>
<tr>
<td>DOWN</td>
<td>60656258</td>
<td>0.62±0.09</td>
<td>BASS-responsive enhancer-binding protein 1</td>
<td>181.56</td>
<td>3</td>
</tr>
</tbody>
</table>

Conclusions

2-D salt plug mass spectrometry showed its good usability as a protein separating technique in analytical researches. We have found 16 differentially expressed protein candidates in this experiment using this proteomics approach. Some of these proteins may play an important role in the development of chick eyes and further studies are needed to elucidate the mechanism of them.

This study was supported by the Centre for Myopia Research (A360), the Myopia Niche Area Fund (J887P), RGC General Research Fund (B-Q15Q) and PolyU PhD Studentship (RPEX)

References

1. Introduction

Cataract patients usually need intraocular lens (IOL) with proper optical power to replace their less transparent or opaque crystalline lens. IOL is therefore an artificial human eye lens. Fig. 1 shows a photo of an isolated IOL.

The necessary IOL power calculation and prediction are generally based on biometrics of cataractous eyes and surgical protocols. Any IOL implantation error such as de-centrations, tilts, axial shifts, rotation and/or combinations of these, reduces the vision quality of the pseudophakic eyes.

Previous studies (e.g. Ref. [1], [2]) have separately considered some of the IOL position errors by use of biometric measurement and/or statistical data. In this study, we use new method based on random mixture of all possible IOL position errors to understand the sensitivity of IOL to its implantation position in individual pseudophakic eyes. We focus on IOLs that are designed for myopic eyes.

2. Purpose

To use real eye’s biometric data to theoretically calculate the influence of IOL’s implantation position errors on pseudophakic eye’s monochromatic wavefront aberrations for individual myopic eyes.

3. Methods

Fig. 2. Working flow chart of individual eye model construction for analysing aberration effect of IOL’s implantation errors

- Subjects selection – clinical eye checks and ocular wavefront aberration measurements
- Corneal topography measurement
- Eye thickness ultrasonic measurement
- Zernike polynomials fit in Matlab
- Individual eye models in Zemax
- IOL designs for each individual eye
- IOL position errors and corresponding optical quality analysis

Individual optical eye models (Ref. [3]) were constructed to design IOLs and analyse pseudophakic eye’s optical quality. We used individual eye’s biometric data measured by corresponding instruments.

Fig. 2 shows a flow chart for constructing individual eye optical model, and customized designed IOLs hereby were incorporated into these eye models aiming to provide proper optical power correction. In this study, we selected 9 eyes data from 6 subjects who have no other eye pathology except myopia, and their ocular wavefront aberrations are in normal range. Nine individual models were constructed for these eyes and different IOL designs were investigated. These designs included:

- the IOLs which only corrected the eye’s spherical refractive error;
- which corrected sphere plus cylinder errors;
- which corrected sphere plus spherical errors and d) which corrected all wavefront aberrations up to 17 ophthalmic Zernike terms.

Although only monochromatic aberrations and their changes at 546 nm wavelength were calculated by ray-tracing method, chromatic effect of all components in the models were included to cover wavelengths shift. Zernike coefficients describing the aberrations and the root mean square (RMS) value was calculated from these coefficients for estimation of optical quality. Pupil size of 5.2 mm and 6 meters distance object were used in the calculation.

Five field points within 2 degree visual field were combined together to estimate RMS value of wavefront aberrations.

4. Results

Fig. 4 shows averaged nine individual eyes’ wavefront aberration RMS values with four types of IOL design. For IOL at its nominal position (best correction position), IOLs with sphere plus cylinder correction, sphere plus spherical correction and full correction can provide significantly better quality compared to sphere only correction IOL (p < 0.05). If IOL implantation position is displaced from its nominal position by means of random displacement mixture, sphere plus spherical and full corrections are significantly more sensitive to their position change than sphere only correction (p < 0.05), while sphere plus cylinder correction has no significant difference with sphere only correction IOL (p > 0.05).

5. Conclusions

In general, for the myopic eyes, sphere only correction IOL is most robust to its implantation position errors than customized IOLs, while customized IOLs offer better correction than sphere only one.

References


Acknowledgements

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Longitudinal observations on the role of the peripheral refraction profile in myopia development

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INTRODUCTION

In recent years the roles of peripheral refraction and ocular shape in the development of myopia are subject of increased interest and discussion (Charman, 2005; Stone and Flitcroft, 2004; Wallman and Winawer, 2004).

Hooogerheide (1971) showed that pilots with relative peripheral hyperopia had the greatest risk of developing myopia.

Methods

- 4-year longitudinal study on refractive development conducted in private optometric practice in Duisburg, Germany
- 140 subjects between 5 and 20 years with visual acuity of 6/6 or better
- Exclusion criteria: ocular or systemic disease, strabismus, astigmatism > 2D, anisometropia > 2D, RGP lens wear
- Measurements at baseline and after 2 and 4 years:
  - Non-cycloplegic mean spherical equivalent refractive error (MSE) centrally and peripherally (25° temporal) using an open-field infrared autorefractor (Shin-Nippon Nvision-K 5001)
  - Axial length (AL) using partial coherence interferometry (Zeiss IOLMaster)

RESULTS

Baseline data

- Baseline MSE between -5.88D and +3.45D
- 44 hyperopes (HYP), 61 emmetropes (EMM) and 35 myopes (MYO)\(^1\)
- MYO had hyperopic relative peripheral refraction (RPR) while HYP and EMM had myopic RPRs (Table 1)

Year 4 data

- 105 subjects completed the year 4 examinations
- 8 EMM became myopic and 22 MYO had progressing myopia\(^2\) (Table 2)
- No statistically significant differences (p>0.05) in baseline RPR between either the stable emmetropes and new myopes or between the stable and progressing myopes
- No statistically significant differences (p>0.05) in 4-year refractive (Figure 1) or axial development (Figure 2) between subjects with a hyperopic RPR compared to those with a myopic RPR for both the MYO and EMM subgroups
- Significant correlation between axial/refractive development and changes in RPR in the new myopes (Figure 3) but not in the progressing myopes (Figure 4)

![Figures 3 and 4. Changes in RPR during eye growth in the new and progressing myopes](image)

![Figures 1 and 2. Changes in refraction and axial length compared in subjects with myopic relative periph. refraction (RPR) and hyperopic RPR in the baseline myopes and emmetropes](image)

\(^1\) HYP = MSE > 0.50D, MYO = MSE < -0.50D
\(^2\) Negative change of MSE > 0.50D

Table 1. Baseline refraction and axial length in all groups

<table>
<thead>
<tr>
<th></th>
<th>Mean central refraction (D)</th>
<th>Mean axial length (mm)</th>
<th>Mean relative periph. refr. (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myopes</td>
<td>-2.36±1.37</td>
<td>24.68±1.09</td>
<td>0.32±0.73</td>
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<tr>
<td>Emmetropes</td>
<td>0.19±0.28</td>
<td>23.06±0.92</td>
<td>-0.34±0.80</td>
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<tr>
<td>Hyperopes</td>
<td>0.94±0.60</td>
<td>22.70±0.77</td>
<td>-0.66±0.85</td>
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</table>

Table 2. 4-year changes in refraction and axial length in new and progressing myopes

<table>
<thead>
<tr>
<th></th>
<th>Changes in mean central refraction (D)</th>
<th>Changes in mean axial length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New myopes</td>
<td>-1.08±0.78 (p&lt;0.01)</td>
<td>0.51±0.44 (p&lt;0.05)</td>
</tr>
<tr>
<td>Progressing myopes</td>
<td>-1.19±0.61 (p&lt;0.01)</td>
<td>0.50±0.25 (p&lt;0.01)</td>
</tr>
</tbody>
</table>

CONCLUSIONS

Consistent with previous peripheral refraction investigations, myopic eyes demonstrated a relative hyperopic peripheral profile while hyperopic eyes showed relative peripheral myopia.

Longitudinal data support the association between myopia formation and concomitant changes towards a more hyperopic relative peripheral refraction.

While the relative hyperopic peripheral profile is a normal anatomical attribute of myopic eyes there is no evidence for it to be a risk factor for the development of myopia.

REFERENCES


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Psychophysical measurements of blur adaptation in myopia

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Purpose
➢ To investigate the differences in blur adaptation between myopic and non-myopic participants using both sinusoidal grating and letter acuity measurements.
➢ To determine whether exposure to visual tasks of varying visual demand affects blur adaptation in these groups.

Methods
➢ Refractive error was measured under cycloplegia at least one day prior to blur adaptation measurements. Contact lenses were used to provide correction during later experimental sessions.
➢ Acuity thresholds were measured in 13 adult participants (7 myopes, 6 non-myopes) using computer-generated sinusoidal gratings (40% contrast) and a high contrast logMAR (Bailey-Lovie) letter chart.
➢ Acuity thresholds were measured immediately prior to, and following induction of 1.00D myopic blur. A period of one hour of blur adaptation was undertaken while the participant performed either a visually demanding task (fast-paced action computer game) [Fig. 1], or a less visually demanding task (slow-paced geometric puzzle game) at a viewing distance of 3 m.
➢ Acuity thresholds were re-measured immediately following the period of blur adaptation both with and without blur.

Results
➢ Following blur adaptation, both myopic and non-myopic participants showed a significant improvement in letter acuity with the blur in place of -0.052 logMAR and -0.084 logMAR respectively (mixed ANOVA, F(1,9) = 5.94, P=0.037) regardless of the visual task [Fig. 2a].
➢ On removal of the blur, myopic participants returned to baseline letter acuity while the non-myopic participants showed a significant improvement over baseline letter acuity (-0.046 logMAR, P=0.018) [Fig. 2a].
➢ The type of video game played during blur adaptation had no significant effect on the above outcome however the non-myopic group exhibited a trend for a greater blur adaptation effect with the action game [Fig. 2b] than with the puzzle game [Fig. 2c]
➢ No significant change in grating acuity was found following blur adaptation, irrespective of the adaptation task (action vs puzzle game) or of the participant’s refractive status (myopic vs non-myopic) [Figs 3a, 3b, 3c].

Conclusions
➢ The observed increase in letter acuity following a one hour period of induced blur is consistent with previous findings that the visual system is capable of rapidly adapting to a degraded visual stimulus.
➢ The differential response of myopic observers to removal of blur (when measured by letter acuity) suggests that this group is less able to adapt to blur.
➢ The differences in adaptation found using high-contrast letters versus sinusoidal gratings suggests that the underlying adaptation mechanism is based on modulating edge-detection sensitivity.
➢ Variation in blur adaptation between myopic and non-myopic observers may be related to the effectiveness of emmetropisation in these two groups.

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Statement on proprietary interests: The authors have no proprietary interests in this research project

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To evaluate the optimal cutoff point for visual acuity and auto refraction result to screen for refractive errors in elementary school children.

Subjects and methods

For a sample of elementary school children, unaided visual acuity with standard distance visual acuity chart, auto refraction and subjective refraction were performed without optical corrections. For subjective refraction (assumed as gold standard) of at least -1.00D, -0.75D and -0.50D for myopia criteria, optimal cut-off point and sensitivity specificity of visual acuity and auto refraction was calculated by receiver operator characteristics curve, respectively.

Result

Total 293 children were tested. Sensitivity/specificity of optimal cut-off point of each myopia criteria was obtained for visual acuity and auto refraction. For at least -1.00D of subjective refraction criteria, optimal cut-off point of visual acuity was 0.5 (sen: 82.5%, spec: 92.5%, AUC: 0.892).

For at least -0.75D criteria, visual acuity was 0.5 (sen: 69.9%, spec: 93.2%, AUC: 0.897), auto refraction was 1.00D (sen: 78.5%, spec: 93.0%, AUC: 0.879).

For at least -0.50D criteria, visual acuity was 0.6 (sen: 72.8%, spec: 88.6%, AUC: 0.883), auto refraction was -0.75D (sen: 82.5%, spec: 86.5%, AUC: 0.858).

Conclusions

To screen for refractive errors with visual acuity and auto refraction in elementary school children, the optimal cut-off point were recommended as decimal visual acuity of 0.5, and auto refraction of -1.13D, respectively.

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