THE BOSTON CHILD SELF-REFRACTION STUDY

Bruce Moore, OD [1], Catherine Johnson, OD [1], Stacy Lyons, OD [1], Nicole Quinn, OD [1], Paulette Tattersall, DipPharm, MSc[1], Joshua Silver, Dphil [2], David Crosby, DPhil [1], Mingguang He, MD[3], Leon Elwein, PhD[4], Graeme MacKenzie, Dphil[2], Nathan Congdon, MD[3]. (1) New England College of Optometry, (2) Oxford University, (3) Zhongshan Ophthalmic Centre, (4) National Eye Institute.

Introduction

According to the RESC Studies[3-13], at least 10% of children in the developing world could benefit from refractive correction. Traditional classroom-based education is visually demanding and an inability to see clearly may have a dramatic impact on a child's learning capability, educational potential and career prospects. Vision impairment due to refractive error is eminently correctable and most children (especially myopes) will experience dramatic improvements in vision with spectacles. However, vast numbers of children live in areas where access to eyecare is unavailable. Variable focus lens (VFL's) spectacles in conjunction with the process of self-refraction may enable these children to receive adequate refractive correction in areas where professional eyecare is absent.

Two major categories of VFL's currently exist, one employing fluid-filled lenses whereby fluid may be injected or removed from a bladder-like sac to change the power of the lens system, the other using the principle of Alvarez optics, employing two lens systems that are moved relative to each other in a spectacle frame, causing changes in lens power. Both VFL designs have been developed into working spectacles that have successfully been used worldwide. The process of self-refraction has been developed to allow the individual to self-adjust the lens power to arrive at an adequate level of vision.

This study on a fluid-filled VFL called the AdSpecs, developed at Oxford University by Professor Joshua Silver, was carried out on myopic teenagers in Boston and in urban and rural locations in China. We report here on the results from Boston. The two China studies have been previously reported[1,2].

Purpose

To determine the accuracy of self-refraction in myopic teenage subjects. We compared both visual acuity and refractive correction obtained through self-refraction with that of a cycloplegic refraction.

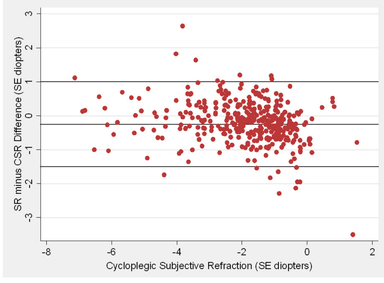
Methods

Subjects performed monocular self-refraction through the Adspecs VFL, followed by VA measured through them. The power of the Adspecs was measured by lensometry. Subjects then had a cycloplegic refraction, autorefraction, and ocular health assessment, with VA measured through the cycloplegic subjective refraction. 350 children 12-18 years of age were recruited from 38 schools in the Boston area. Self-refractions and eye exams were conducted on the 38' Vision In Preschoolers Study Vision Van, with a working distance of 3 meters. The self-refraction by the subject was carried out under protocol and moderated by an OD, and the cycloplegic exam performed by an OD masked to the results of the self-refraction.

The inclusion criteria were unaided VA ≤ 20/40 in one or both eyes, best corrected cycloplegic VA ≥ 20/32 in both eyes, myopia ≥ -1.00D in one or both eyes, ≤ -7.75D in both eyes, ≤ -2.25D astigmatism in both eyes, and no ocular pathologies, strabismus, or amblyopia.

Results

- Self-refraction resulted in a mean spherical difference of -0.23D (standard deviation: 0.67D) compared to cycloplegic subjective refraction.
- 98.72% of 700 eyes achieved VA ≥ 20/32 and 92.15% of 700 eyes achieved VA ≥ 20/25 through their self-refraction.
- Only 2 subjects (0.571%) could not obtain ≥20/32 in their better eye, and only 9 eyes (1.28%) could not obtain ≥20/32.
- Of the 78 eyes having astigmatism between -1.25D and -2.25D along with their myopia, none of those eyes were unable to obtain ≥20/32.



Bland Altman plots comparing cycloplegic subjective refractive error with self-refraction in the right eye. The horizontal lines represent, from top to bottom, the 97.5th percentile, the median and the 2.5th percentile, respectively.

Results con't

Discussion

This study, carried out on a diverse group of myopic teenagers in Boston, confirmed data previously published on both urban and rural teenagers in China[1,2], that the process of self-refraction produces excellent visual acuity in almost all subjects and a refraction that is, in most subjects, very close to that of cycloplegic refraction.

Of those 9 eyes (out of 700 total) unable to obtain 20/32 or better VA, 4 were under-minused, 2 were over-minused, and 3 were in close refractive agreement with cycloplegic refraction but still had reduced VA. None of the myopic eyes with astigmatism between -1.25 to -2.25D were unable to obtain ≥20/32VA, suggesting that in this sample, moderate levels of astigmatism did not significantly reduce VA when the myopia was adequately corrected by self-refraction. Mean self refraction was very close to that of cycloplegic subjective refraction, but the individual variation in self-refraction was quite large. Why this "scatter" and what, if anything, can we do to reduce it? It might be due to issues related to the design or ergonomics of the VFL spectacles, instructions to the subjects, the short (10 foot) working distance constrained by the exams taking place on the size-limited mobile van, or other factors. Research on the technique of self-refraction and improvements in the design of the VFL's and spectacles are ongoing to attempt to reduce this variability.

What might be the potential future role of self-refraction as a means of addressing the massive unmet burden of uncorrected refractive error in the developing world? This study, and those from China[1,2], show the accuracy of self-refraction as both a refraction technique and as a treatment modality for myopia. It might also be useful as a screening tool in conjunction with VA testing, i.e. by screening for uncorrected reduced VA followed by self-refraction to determine if myopic

Discussion cont'd

correction can improve VA. If VA does improve, refractive correction can be provided. If VA does not improve, referral to limited professional eyecare resources would be indicated, and since the quality of these referrals would be improved beyond that of unscreened populations, efficiency would be greatly enhanced. This could be viewed as an early stage in the development of a comprehensive system of care.

Future efforts will be directed at improvements in the technique of self-refraction and further design and development of the VFL's and spectacles to improve their ergonomics and cosmesis.

Conclusions

The VA through self-refraction resulted in excellent vision for most subjects, and the refractive accuracy was a mean of less than 0.25D overminused compared to cycloplegic refraction. The combination of excellent vision and accurate spherical refraction derived from self-refraction provide encouragement for further investigation of this technique for myopic children in regions where access to refractive care is limited or absent.

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The following potential conflict of interest exist:
Employee (MacKenzie)