Understanding and controlling myopia

Duration: 2 hours
COPE Category: Disease

Summary:
In order to develop effective optical treatment strategies for myopia, it is important to understand how visual experience influences refractive development. In this respect, research involving many animal species has demonstrated that refractive development is regulated by visual feedback associated with the eye’s effective refractive state, i.e., defocus. Detailed knowledge of the effective operating properties of these vision-dependent mechanisms is critical to optimizing optical treatment strategies to reduce myopia progression. Results of recent animal experiments that have provided new insights into the nature of visual signals that influence eye growth and how these signals are integrated across the retina are also discussed.

Understanding myopia control in the context of public health is important because of the recent rapid rise in the prevalence of myopia globally and the future projections of myopia reveal that there will be 4.5 billion myopic in 2050. The risks to vision impairment and blindness through myopic macular degeneration and ocular diseases are emerging as a frequent cause of blindness in China and Japan and will likely be the case elsewhere with the growing prevalence of myopia and high myopia. The translation of animal experiments and clinical research looking at optical, therapeutic and behavioural strategies to control myopia will be discussed so that the eye care practitioner can make informed decisions in managing young patients with myopia based on the latest innovations in myopia control research.

Learning Objectives:
By attending this presentation the participant should be able to:

1) Describe the current prevalence and trends for myopia and high myopia across the world
2) Describe the contribution of high myopia to vision impairment and blindness
3) Describe how myopia leads to vision impairment and blindness
4) Describe the signs of myopic macular degeneration
5) Describe the potential role of visual experience in early ocular growth and the possible effects of spectacle lenses on emmetropization.
6) Identify the factors associated with early visual experience that may alter ocular growth in animals and humans.
7) Describe the variations in the normal pattern of peripheral refractive errors and the relative role of peripheral vision in refractive development.
8) Describe the current myopia control strategies optometrists can utilise in the management of their patients with myopia
9) Describe the future myopia control options that will become available to the patient
10) Identify the behavioural and lifestyle changes that can be incorporated with optical and therapeutic myopia control strategies
11) Make informed decisions concerning the use of traditional optical and pharmaceutical myopia therapies.
12) How to present myopia control to parents, children, teachers, and other health care professionals – advocacy on a local and global level.

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Disclosures: The Brien Holden Vision Institute and Earl Smith III have patents in myopia control.
**Speaker 1. Who is at risk and what are the consequences of high myopia?**

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**Outline**

1. Epidemiology of myopia and high myopia
   a. Prevalence of myopia
      i. Current rates of myopia across the world
      ii. Trends in myopia across the world
      iii. Prevalence of myopia in North America in the past, now and in future
         1. Trends in myopia in North America
   b. Prevalence of high myopia
      i. Current rates of high myopia across the world
      ii. Future rates of high myopia across the world
   c. Increasing levels of myopia cause vision impairment and blindness
      i. Review of the literature showing the risk of cataract, glaucoma and retinal pathology due to high myopia
      ii. Myopic macular degeneration
         1. What is it?
         2. Signs of myopic macular degeneration?
         3. Prevalence of myopic macular degeneration
      iii. ZOC-BHVI high myopia study
         1. Rates of retinal pathology in high myopia
            a. The relationship between age and retinal pathology
            b. Significant associations between the amount of myopia, the change in axial lengths, and age with retinal pathology
         2. Relationship between vision impairment and high myopia
            a. Significant associations between vision impairment and age, axial lengths, amount of myopia, gender and parental myopia.
         3. Rates of progression in high versus low myopia in children
            a. Association between baseline myopia, gender, parental myopia with rates of progression
   d. Identifying those that will develop high myopia
Speaker 2. What’s new in the understanding of myopia induction?

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Outline

I. Evidence that visual experience regulates ocular growth and refractive development
   A. Form deprivation myopia
      1. Observations across species
      2. FDM in humans
   B. Recovery from induced refractive errors
      1. Age dependence
   C. Lens compensation experiments.
      1. Nature of Vision-Induced Refractive Error
      2. Clinical Implications
   D. Emmetropization
   E. Interspecies comparisons

II. Operational properties of vision-dependent mechanisms
Submission for Ellerbrock lecture

A. Evidence for local retinal mechanisms
   1. Hemi-retinal form deprivation and defocus
B. Simultaneous competing defocus
   1. dual focus lenses
C. Temporal integration of myopic defocus
D. Effects of age

III. Relative role of central and peripheral vision in refractive development
A. Effects of foveal ablation
   1. emmetropization
   2. form deprivation myopia
   3. recovery from induced refractive error
   4. compensation for hyperopic defocus
B. Effects of conflicting central and peripheral visual signals
   1. peripheral form deprivation
C. Spatial summation of defocus signals

IV. Effects of high ambient lighting on vision-induced myopia.
A. form deprivation myopia
B. lens-induced myopia
   1. chickens and tree shrews vs monkeys
C. mechanisms that mediate effects.
   1. dopaminergic mechanisms
   2. pupil effects

V. Effects of the spectral composition of ambient light
A. predictions from longitudinal chromatic aberration &
   experimental results
   1. chromatic mechanisms
   2. effects of monochromatic environments
Submission for Ellerbrock lecture

B. blue light treatments for myopia

1. spectral composition of ambient lighting

Speaker 3: Where to from here? Possibilities, probabilities and certainties.

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Outline

1. Myopia control strategies in humans and their impact on the rate of progress of myopia
   a. Optical strategies
      i. SPECTACLES
         1. Executive bifocals
      ii. CONTACT LENSES
         1. Concentric bifocal contact lenses
            a. Optical properties
            b. Evaluation of visual quality in the China Myopia study
         2. Peripheral plus contact lenses
            a. Optical design
            b. Evaluation of visual quality in the China Myopia study
         3. Orthokeratology
            a. Optical design
            b. Rebound effect
   b. Therapeutic strategies
      i. Atropine
   4. Filters
   5. Extended depth of field (EDOF) contact lenses
      a. Evaluation of visual quality in the China Myopia study
      b. Dose response relationship on axial length change and change in refractive error
Submission for Ellerbrock lecture

1. Current uses
2. Efficacy
3. Rebound effect
4. Adverse effects

ii. 7-MX
   1. Efficacy in animals and humans
   2. Dosage
   3. Pharmacological action
   4. Adverse effects

C. Outdoors
   i. Efficacy
   ii. Treatment duration

D. Behavioural strategies
   i. Reduced time spent at near
   ii. Bars on desks
   iii. Lighting

E. Genetics

F. An integrated approach

G. Identifying those that would benefit from myopia control, how to apply myopia control, what to apply and when to intervene
   i. Eyemapper
      1. What is it and how can it be used?
   ii. Effect of ethnicity on myopia progression
   iii. Family history of myopia
   iv. Personality/behaviour of child e.g. spends a lot of time indoors
   v. Impact of myopia control on the number of people with myopia in future
   vi. Impact of myopia control on the number of people with high myopia in the future
   vii. Impact of myopia control on myopic macular degeneration and other forms of blindness due to myopia in the future

H. Advocacy strategies
   i. IAPB
   ii. WHO
   iii. The Myopia Institute
   iv. WCO and ICO
   v. The Public, Teachers, Students